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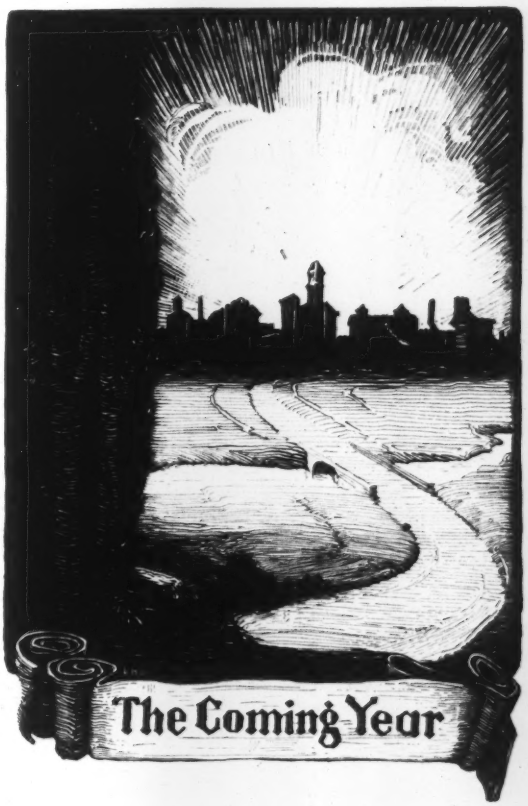

Volume 92 January 3, 1924 Number 1

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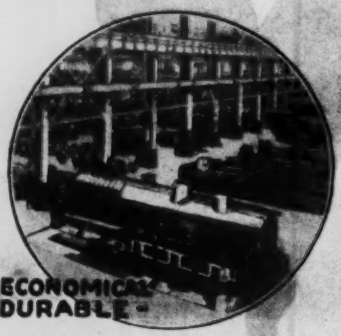

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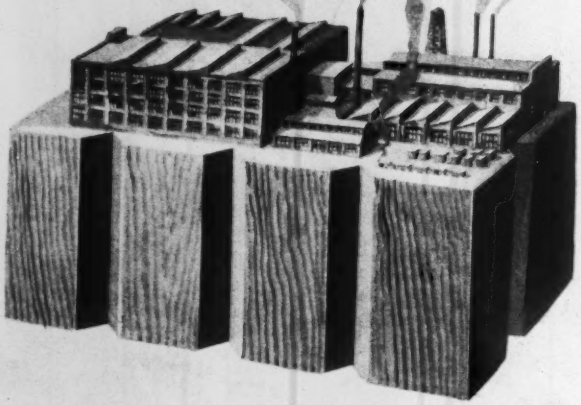

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT, *Editor*

Volume 92 — NEW YORK, JANUARY 3, 1924 — Number 1

WITH this issue Frank C. Wight becomes Editor of *Engineering News-Record*, succeeding E. J. Mehren, who will henceforth devote all his time as vice-president of the McGraw-Hill Co., to the publishing management of four of the McGraw-Hill papers, including *Engineering News-Record*. With his increased responsibility as publisher, Mr. Mehren's opportunity for being of service to the profession and the industry which he has so long served as editor is much broadened. His contacts with the field, his interest in its activities will accordingly be greater, if possible, than before.

Mr. Wight comes to his new responsibilities backed by an experience of 17 years with *Engineering News* and *Engineering News-Record*, and by an editorial staff exceptional in size, ability and length of journalistic service. He inherits a great tradition. Upon his shoulders falls the mantle of Stauffer, of Wellington, of Charles Whiting Baker and John M. Goodell. It is a heavy responsibility. But it is also an opportunity for service such as comes to few men.

The publishers entrust the editorship to Mr. Wight confident that through the ability and earnest support of the staff and with his knowledge of the field, his clearly demonstrated engineering ability and journalistic judgment, his vision and his courage, he will not only maintain the best traditions of the past but will mold the paper to the problems of the new day and, by distinguished service to the men, the societies, the associations and corporations in the civil engineering profession and the construction industry, carry *Engineering News-Record* to greater heights of journalistic accomplishment.

THE PUBLISHERS.

The Year Ahead

ENGINEERING practice partly reflects and partly absorbs all economic changes. As a science, engineering may continue aloof from the shifts of demand and supply or the variations in the social organism, save as necessity must cultivate invention. But the things the engineer builds are the things the world uses, so it follows that to the degree that the world wants things, can use them and can pay for them, to that degree the engineer is going to be required to supply them. A review of the engineering year, therefore, with its lessons for the future, must consider some basic economic and political facts before passing on to the technical developments that mark progress.

The Economic Situation

BUSINESS has been remarkably stable throughout the year. Profiting by the experiences and depression of 1921 manufacturers, wholesalers and retailers have been careful not to overstock. There has been little inflation. Savings deposits are high, transportation has measurably improved, wages have been good. In consequence of the stability thus engendered there has been a reduction in the margin between producer and consumer which, while not yet productive of any general price reductions, has at least prevented that price variation which is the forerunner of panic. Stability has been achieved; the next step is lower prices and a better distribution of prosperity. In the way of that are several barriers, some of which are noted in succeeding pages. Besides them we can not go ahead until there is alleviation of agricultural distress, lowering of government expense with its consequent growing burden of taxation, and settlement or approach toward settlement of the European muddle. In all three of these the prospects are more favorable than not, though many difficulties hedge each one about.

The problem of the farmer is mainly the problem of distribution, complicated by his isolation, which has hitherto prevented him from combining as have the city dwellers to maintain high wages and prices. Because he is remote from that which he uses he pays high for it; because his markets are remote from him he must suffer the high cost of getting his produce to them. His present difficulty is no new thing. It has been with us in America since the great Middle West opened and has taken form in successive movements. Because all sought novel and rapid forms of relief, they have been all termed radical. Slowly the good elements of their programs have become embodied in our law and accepted as truth by the conservatives, and the bad elements have fallen by the wayside. That is the function of the radical, and that will be the function of the radicals now representing the great agrarian movement, which holds the balance of power in our national legislature. Insofar as the present farmer difficulties lead to easier farm financing, better control of marketing and more intense farmer co-operation, the agrarian uprising is something to applaud. And as a check on too inbred a view of the inherent and divine right of what for want of a better term is called "big business" the farmer strength is salutary.

Taxes continue to mount in the face of stable or decreasing unit costs. The government is doing more and more and charging more for doing it. There are signs of relief, though as yet they are but signs. In city, county, and state, those in control have their ear to the ground and hesitate to budget a year ahead greater than the year before. There is hope that the disease will cure itself before it kills. For the federal government the way out has been pointed by the Secretary of the Treasury and every day shows how popular his program is. This being the presidential year there will be the usual jockeying for position, but it is inconceivable in the face of the clear fiscal policy outlined by Mr. Mellon that the punitive idea of taxation will prevail in Congress or that a mistaken idea of generosity toward the able-bodied veteran should be allowed to swamp an already overburdened national budget.

On account of the condition of Europe we are still suffering from the effects of the war. Early last year

France went into the Ruhr. She is still there, and the reparations which she sought are no nearer being paid. She herself is piling up a self-absorbed debt while the franc falls. England deprived of continental trade by German poverty and of a protective tariff by the vote of its people is floundering around for a way out of dire unemployment. Germany falls daily further into the abyss of the non-producing consumer. It is only within the past few weeks that there has apparently come to Poincaré—who both rules and personifies the French—an appreciation of the necessity of some withdrawal from his policy. An independent commission, on which happily sit three distinguished and able Americans, will once more attempt to fix Germany's capacity to pay. In that commission with the relaxation of the French attitude that it connotes lies the brightest spot ahead in the European situation.

Construction and Contracting

CONSTRUCTION has been active. Public work and building have continued in enormous volume throughout the year. In another place in this issue specific figures are given, but the total construction was greatest in volume ever recorded—leaving out of account the two war years. With a cost index averaging 23 per cent greater than 1922, the total for 1923 was six billions of dollars against four and one-half the year before. What next year will bring depends on many things. Comparing figures of prospective work for the past few years, however, the prospects are that the totals will be not quite so great as 1923 but greater than any other year—say five billion dollars. If prices drop, the total may run higher; if they rise there will be a buyers strike and a consequent slump.

Co-ordination has progressed apace in 1923. There has been encouraging development, through the joint committee of architects', engineers' and contractors' associations, of agreement on uniform contracts. Arbitration as an essential element of construction contracts has made a long step forward by its adoption in federal contracts. Encouragement of vocational training and increased apprenticeship is promising a more constant supply of skilled labor. Spurred on by the Department of Commerce there has come about notable simplification in materials and equipment—varieties have been decreased and standards settled upon. Outstanding is the vital interest aroused and the actual progress made in reducing seasonal construction.

Most progress in twelve-months-a-year construction operations has been made by building contractors. Indeed in steel-skeleton and in reinforced-concrete building they make no distinction between seasons in beginning construction and scarcely a distinction in price of work performed in winter and summer. All this is not the development of 1923, but in this year the fact has been constructively applied to the creation of public sentiment for year-around construction. In other construction than building the habit of winter idleness is slower in being overcome. Yet there is an increased tendency to let contracts all the year around, to accumulate and store in winter the materials for warm-weather operations and to do winter grading and excavation. In general there is coming slowly a twelve-months construction year.

Arbitration in construction contracts has a significance beyond the fact that it provides a means of excluding the law courts in adjusting disputes. It indicates a growing tolerance in contractual relations—an increasing recognition that construction is a true partnership of effort and obligation between owner, engineer and contractor. Of the same character is the joint effort of public works engineers and contractors and particularly those occupied in highway building, to work out practices in surety bonding which will be less subject to criticism.

Labor Sources

LABOR continues to be the difficult element in the construction industry. Materials have been plentiful and their price while tending downward only in small degree has at least been such as to permit of a safe estimate for the life of most contracts. Labor, on the other hand, has been scarce, with the consequent result that it has been high priced and not overly efficient. The condition is quite logical. Construction volume continually increases but the labor supply remains about as it was before the war. Common labor is coming in small quantities from foreign lands, its principal source in the past, and skilled labor, practically all unionized in the building trades, suffers numerous restrictions. The solution of the common labor shortage lies in immigration law reform, of the skilled labor shortage in education of both employer and employed, and the development of a pride in craftsmanship on the part of our young men.

The current immigration law, with its outrageous quota-restriction operation, expires this year and must be replaced. Days of talk and reams of paper were wasted last year in discussing the new law. The outstanding fact, which is too often lost in the welter of words regarding racial and geographical source of our immigrants, is that we want strong bodies and honest minds to take up the burden of our manual labor, and there is no way of insuring these qualities by makeshifts of quota or source. Second generation Americans are more or less indistinguishable as to source; the trouble is that all immigrants are first generation Americans. Lacking the courage to institute forced diversion of the immigrant stream to the farm and the construction job that needs them or to permit the employer to seek his man wherever abroad he can find him, there remains nothing for us to do but to continue with some form of quota restriction, relieved, as it no doubt will be, by more scientific methods of refusal of the unfit before they reach our shores.

The shortage in skilled labor cannot be laid to restriction in immigration. Practically as many building mechanics have come to our shores in the years since the war as in an equal period in the past. Skilled building mechanics come up from apprenticeship and that source has been seriously restricted in recent years. Most of the blame lies in the labor unions which have intentionally restricted the apprentices but no small part lies in the employers who have not been sympathetic to the apprentice system or offered much encouragement to the young man to learn a trade. The situation is undoubtedly improving. Through the medium of such organization as the building congresses and the American Construction Council co-operation between employer and union is being promoted to the end that hopeful apprenticeship systems are being adopted. These systems presuppose the co-operation of the public schools, the willingness of the employer to

permit the apprentice a certain amount of study off the job and to insure him work and, what is most important, the agreement of the union to allow a necessary number of apprentices. They still suffer from what seems to most engineers an undue requirement by the union as to length of the apprenticeship.

Crossing the Rivers

ACTIVITY in the field of bridges and other steel construction has largely been of routine character, with one prominent exception, namely the planning of large stream crossings for highway purposes. The problem of providing such crossings in adequate number has existed for many years, but the growing traffic of the recent past has made it urgent. At dozens of points in the country, large regions are separated from each other along a length of a hundred or several hundred miles by a river wide and deep enough to make its bridging a costly matter. The Missouri, Mississippi, and Ohio are notorious instances; but even much smaller rivers have produced the same result, among them the Delaware, the Hudson, the Tennessee, the Columbia, and others. During the last three or four years ago the needs of road transportation have begun to exert a sufficient pressure to force action toward the abolition of such stream barriers. Since then a great deal has been done, and more is likely to be done within the next few years.

The Delaware River is being bridged at Philadelphia; the Hudson at Bear Mountain and perhaps in the near future also at Poughkeepsie; four bridges crossing the Missouri River are being constructed in Missouri; three bridges have just been completed across the marshes of the main drainage streams of South Carolina; a large bridge is just being started across the Columbia; Carquinez Straits are being bridged; plans are under discussion for a new Ohio River bridge at Louisville. These and other items of similar activity represent the beginning of what promises to be a steady campaign of construction in this field for quite a number of years. Unfortunately the big problem of a Hudson River bridge at New York has not come materially nearer its realization, despite much discussion. The badly tangled transit condition of New York City is in part to blame for this.

Two tendencies have been exhibited in this bridge construction. It is not yet clear which will prevail. State enterprise is building some of the structures, while others are being built by private enterprise. It is to be remembered that the kind of structure under discussion represents in each case a very large investment, and that available public moneys are none too ample. At many of the crossings there are ferries, on which tolls are charged, and it seems quite logical that the bridge should also collect its returns from the traffic using it, by being built as a toll bridge. For such reasons as these, toll-bridge enterprises have come into being at Carquinez Straits, at Bear Mountain and some other points, while the Missouri bridges, the Delaware River bridge and others are being built with public funds. In such a case as the Philadelphia-Camden bridge over the Delaware, joint action of the two states and the municipalities involved is able to deal with the huge cost. But where a costly bridge is demanded at a location far from a city, the funds are more readily found through private investment. At the present time it seems likely that both classes of bridge, private and public, will have a field for a good while to come. Possibly in the end it may become established principle that every bridge should be free just as the road is free. For today this can not be said to be true, so far as very large bridges are concerned.

Railroad Development

THE past year has been a most remarkable one for the railroads, not in physical growth, although that item has been considerable, but in a general improvement of existing properties, a great increase in equipment, and a most unusual step forward in operating efficiency. Of all three the improved operating efficiency is the most commendable as being indicative of a spirit of co-operation among railroad officials and men which has resulted in carrying the railroads through the greatest peak-load period in their history without the wasteful congestion and delays of former years. A large part of this successful passing of the peak load period is due also to the activities of the American Railway Association in inaugurating a program to provide adequate transportation by increasing the load per car and the miles per car per day, and to decrease the number of cars and locomotives under repairs. The association also advocated the purchase of much new equipment, and despite the poor financial condition of most of the railroads the total number of new cars and locomotives in service on December 1 was 177,845 cars and 3,704 locomotives, with 21,392 cars and 501 engines still to be delivered to complete the orders outstanding. This is an increase of 8 per cent in the number of cars and 6 per cent in the number of locomotives in service Jan. 1, 1923.

In design this new equipment follows the tendency of recent years toward increasing the unit capacity of both cars and engines. The cars have no unusual features but there have been some unusual engines put out during the year.

Although new construction has been confined largely to additional tracks, new or enlarged terminals, or line revision, yet the number of miles of new railway actually under construction is surprisingly large.

Multiple track and new or enlarged terminal construction, grade and line revision, and grade separation work has been very general over the whole country.

Railroad electrification has not made the strides that many people predicted it would, largely because of the expense involved and the improvement in steam locomotive design. Few railroads are in a position to scrap millions of dollars worth of steam locomotives for the relatively small increase in efficiency that electric traction gives over steam on most divisions. As long as coal and oil are plentiful steam will probably continue to be used except in such locations as mountain divisions, congested terminals, tunnels, and divisions where the traffic is largely rapid transit to suburban territory. In general service electric traction makes the best showing in mountainous territory where the traffic is heavy. An example of this is the recently undertaken electrification of 132 route-miles of the Virginian Ry., the largest single electrification contract ever made.

Automatic train control devices have been installed on a number of test sections throughout the country, and it is quite likely that, as a result of the Forsyth accident in December, there will be increased activities along that line this year. It is to be hoped that there will be no rash attempt to force large installations until the various devices have been submitted to severe serv-

ice tests. The nine-year test made on a 107-mile section of Chicago & Eastern Illinois track is an indication that at least some of the devices will give satisfactory service.

Our Power Resource

YEAR by year, water power takes on added importance as a national resource. At some time in the future, no doubt, we will be making use of all the water power in the country, either through local consumption or, more probably, in large part through interlinking of local powers by huge transmission networks. Already on the Pacific Coast and in part of the southeastern region such networks have developed, the western ones by aid of the extreme transmission potential of 220,000 volts, a new achievement of the year. In the industrial states such development has lagged, but this condition will not continue indefinitely. Even today few water powers are limited to the value which they can acquire through a market developed on their river banks, and it may be that in time virtually all powers in the country will have substantially equal value per horsepower delivered.

As that time approaches, the question of primary and secondary power uses will become quite as acute as the parallel question of primary water use in the arid regions, where there is not enough water to go around. With the approach of this time—or even now, when that time is still a long way in the future—the ultimate control of our power resources comes to be an important national issue. At present, policy in this field is yet vague and much in dispute. Inevitably it tends to become more and more a subject of contention, as the issue becomes more urgent. Partly for this reason the power element in western irrigation questions has a weighty influence on the contests to which they give rise. All things considered, it is none too early to begin thinking about a consistent power program, keeping in mind the fact that development must be systemmatically co-ordinated unless wasteful inefficiency is to result in the end, and on the other hand the fact that we cannot afford to wait for complete development of a whole stream system, in most instances. It is desirable to make provision for the freest possible interplay of private and public enterprise, and yet to guard carefully against the day when we may be in the same unfortunate position with respect to water power as we are today with respect to coal.

Chicago's Water Diversion

THERE is no better example of the complications which arise in the disposition of water than the case of the Chicago diversion, the main features of which are outlined as a matter of record in this issue. Navigation, power, sanitation, flood control and the disposition of international waters—for Lake Michigan is international—all enter into the controversy, and the relative authority of state, nation and foreign nation tend still further to confuse. For years the situation has cried out for clarification but legal delay, persistence in a fixed course by Chicago and the inevitable slowness of international negotiations have served to keep it in *statu quo*. Either by act of Congress, afterward to be interpreted by the Supreme Court, by decision of that court in a submitted case, or by international treaty, or by all three, the right of Chicago for all time to divert water from the Great Lakes for what is soon bound to prove an antiquated system of sewage disposal—or for power or for another navigable outlet to the sea—must be definitely determined. The issue is important as it affects the interests specifically concerned but it is more important as the foundation of broad policy to apply to the changing needs of water use.

Hydro-Electric Progress

AS EVIDENCE of the growing importance of water power the tabular record of current hydro-electric plants on p. 32 is offered. In no other line of engineering is there such activity, for besides the plants listed as being already under construction there are numerous developments in prospect which are certain to be undertaken and others still which will be undertaken once the legal impediments due to interstate conflict or ill-conceived ideas of conservation are removed.

It is interesting to note that eight of the thirty-six Western projects tabulated are municipal ownership ventures. Falling in line with Seattle, San Francisco and Los Angeles, the smaller cities such as Eugene, Ore., and Aberdeen, Wash., are venturing into the municipal power field.

The year's developments have been notable in two respects, the enormous size of some of the individual units and the unprecedented amount of the total horsepower installed. In the United States and Canada at the beginning of 1923 approximately 12 million horsepower was being generated by water; in 1923 a million more was added and there is now under construction about 2,700,000 hp.

In regard to individual units the year has brought out many novel turbines. Chief among them are the three 70,000 hp. turbines on the American side at Niagara, turbines of a size never before attempted, and, if the judgment of many hydraulic engineers is correct, a size that will never again be built, for although as a general rule the economies to be derived from an installation increase as the turbines increase in size there is a point beyond which other factors enter in to offset the advantages of increased size. This point, it is believed, has been passed in the Niagara wheels but space restrictions at the site of the power house made such large units necessary. Other notable turbines are the four 16-ft. propeller-type units of 33,000 hp. each at the LaGabelle plant of the St. Maurice River in Quebec. They operate under a head of 60 ft., the highest head ever attempted with this type of wheel. New high-head turbines in the West include two 14,000 hp. single overhung impulse wheels in the Eldorado plant in California which operate under a head of 1,750 ft.

The past year has also seen some remarkable developments in auxiliary features designed to improve the output of hydro-electric plants. The first of these is the use of the back-water suppressor, an arrangement of the spillway whereby flood waters are led down into the tailrace in such way that by their velocity they force the backwater out of the portion of the tailrace directly in front of the draft tubes and so increase the effective head on the turbines. The other arrangement, known as the ejector type draft tube, is one in which flood waters are admitted to the back of the lower part of the draft tubes in such a manner that they force out the water in the lower part of the tubes at a greatly increased velocity thus increasing the vacuum acting on the underside of the turbine.

The Upheaval in Reclamation

FOR years no event has occurred to disturb so profoundly the relation of engineers to the national public service as the upheaval of the Reclamation Service initiated last June by the dismissal of Arthur P. Davis, director of the Service. In spring a Western medical man, Hubert Work, was named Secretary of the Interior to succeed Albert B. Fall. In June the new secretary summarily dismissed Mr. Davis on vague allegations of incompetence and unfitness for the position of director, regardless of the fact that Mr. Davis occupies a recognized position of prominence in the civil engineering profession, had recently been president of the American Society of Civil Engineers, and had twenty years of experience in reclamation, being one of the original members of the Service and for a long time its chief engineer. Civil service regulations no less than ordinary justice required the secretary to bring specific charges against Mr. Davis; but this requirement was evaded by the old political device of changing the name of the position. Subsequent developments indicate that the dismissal had been decided upon a long time before, and that in all probability it was an understood matter between Secretary Work and his predecessor. It seems probable also that ordinary political patronage considerations entered the case, for the secretary named as A. P. Davis' successor a politician who just previously had been given a supernumerary place in the Department of the Interior and indeed had been suggested as Fall's successor.

In the background of the case was the well-known fact that Arthur P. Davis through steadfast adherence to the law and to the dictates of public interest had drawn upon himself the hostility of a number of Western interests, including irrigation promoters, seekers after large water-power grants, and representatives of land owners on reclamation projects who were delinquent in their payments to the government. There is a well-defined possibility that these interests succeeded through political avenues in persuading the new secretary that he would satisfy a general wish of the West if he ousted Mr. Davis. The effect of his action, however, was to awaken a general storm of protest in the country, emanating from engineers, public bodies, citizens and newspapers, all of whom recognized the sinister political character of the move and foresaw its disastrous effect on the interests of reclamation.

The Reclamation Service organization was shaken to its foundations by the dismissal. This effect was increased by many statements issued from the secretary's office derogatory to engineers and their achievements, by invitations which he issued broadcast to complain of the Reclamation Service operations, and by his active interference with and disorganization of some units of the Service, all of which brought about a general upheaval in the field of federal irrigation.

Late in summer, after this mischief had been done, the secretary appointed a committee to study reclamation. At first known as the Fact-Finding Commission, this body is now in session under the name of Committee of Special Advisers on Reclamation. It includes such able men as James R. Garfield, Secretary of the Interior under Roosevelt; Elwood Mead, chairman of the California Land Settlement Board; Dr. John A. Widtsoe, former Utah college president and a prominent irrigation authority; and Thomas H. Campbell, former Governor of Arizona. While there have been many investigations of reclamation during the past dozen years, and the committee therefore will, in large part, work over old ground, its findings should prove of great value at the present critical period.

By these developments the entire subject of reclamation has come to the front of the public stage. The reclamation policy framed twenty-one years ago, when the present Reclamation Act was passed, in Roosevelt's first administration, has worked out in many respects far different from the original intention. The provisions of the old act have proved to be unsuitable in many respects ever from past irrigation enterprises, and are practically unworkable in application to further reclamation development. Yet a large number of new reclamation projects has been proposed in recent years to take advantage of federal no-interest funds. Thus, the subject of a national reclamation policy needs reconsideration from the ground up before anything further can be done. It is this fact that makes the reclamation subject of primary interest during the coming year. There should be ample opportunity for engineering bodies to co-operate in working out the problem.

Municipal Progress and Problems

MEASURED in terms of contracts let, even after allowing for the 47-cent dollar, an immense volume of municipal work was put under way in 1923. Taking into account population growth and the still more rapid increase in imperative demands for municipal service of all sorts, it appears doubtful whether we have yet more than fairly begun to catch up in municipal construction. Encouraging as is this large amount of municipal work it has a serious aspect, for to finance it requires 2.14 times the bond issues or tax levies that would have sufficed in 1913. This is accelerating the approach to bonded debt and tax levy limits, where not already reached, and it contributes to tax rate increases that are not relished by the taxpayers.

In the face of this it is appalling to see how much remains to be done in the way of much needed municipal improvements. Perhaps this is nowhere more apparent than as regards paving, which is noted in a succeeding paragraph. Next in order of much needed municipal engineering construction comes sewerage. Water supply probably stands best of all, both as to quantity and quality of service rendered. Perhaps satisfactory means of garbage collection and of disposal are as far or even farther in arrear than is true of sewerage facilities, but from the viewpoint both of health and comfort, this matters less.

While it is true that very much might be done in all the municipal engineering fields mentioned, it is encouraging to note the rapidity with which these and other services are being extended to small municipalities, including tiny villages. In many states it is becoming common for places of a few hundred to a thousand people to have or to be getting water-works, sewers, and electric lights, with paving to follow as the bonds for the other improvements begin to be paid off.

Barring the continued progress in engineering design incident to any live art—and this art is live—water-works, sewerage, paving, and garbage disposal practice may be said to be very well standardized, although the search still continues and always will continue for reducing capital and operating charges. Many notable features in these fields are the rapid extension

of water treatment even to the extent of what a few years ago was called "water refining"; increasing confidence in the activated-sludge process of sewage treatment; and a continuation of the unstability of garbage disposal. The latter is due not to the engineering status of the art, but rather to the continued unwillingness, if not stupidity, of the laymen municipal authorities to seek proper engineering advice.

City Paving and Traffic

RECOVERY of the arrears which piled up during the war and readjustment period is the all-absorbing task in city paving. Nothing outstanding has been accomplished in solving the broad and pressing paving engineering problems which are bound up with street traffic. In the new construction, pavements are being made a little thicker and stronger and generally both materials and workmanship are improved. All cities are hesitating before the real problem of street engineering of which pavements and traffic are inter-related factors.

The heavy truck and increased speed of vehicles have placed a new burden on paving engineers. This fact is obvious. What the extent of the burden will be is not at all obvious. If freedom of all streets is to be permitted to heavy trucks then the paving task is quite different than if trucks are confined to certain streets. If freedom of parking is to be general then paving design is a different task than when the full street width can be considered to be the traffic width. Again if truck loads are to be a certain amount or some lesser or greater amount, the design problem changes. Also whether or not legal load limitations are actively enforced has a bearing on design. Last year consciousness of these new phases of pavement engineering became alert perhaps largely because the work of recovering the arrears in paving became more active. This is the outstanding city paving development of the year—the consciousness that paving engineering is in part traffic regulation.

In pavement design and pavement structure the tendencies of previous years have developed a little further in 1923. Simplification and standardization of materials have advanced. Types remain about the same in order of use—bituminous pavements far ahead of all others. Shoving and rutting continue to be the most universal trouble and there has been movement toward a general stiffening up of asphalt mixtures.

Traffic congestion is becoming so serious that the continued amateur disposition of the problems is most disturbing. The situation is well outlined in the article by Mr. Bibbins in this issue; not until our cities consider traffic as a major engineering problem and turn it over to engineers to settle will there begin to be relief.

Highways

A YEAR ago it was indicated that production seemed to have become stabilized in roadbuilding. This conclusion is more certain after twelve more busy months of highway construction. Exactly how much greater or less the mileage and expenditure were in 1923 than in 1922 is not known but the difference is relatively not great and by any count the total is tremendous. It is customary, and, in round figures, reasonably precise to say that the total expenditure annually is a billion dollars including all roads and all improvements.

With the development of road improvement into a continuing business there has come the consciousness that the principles of permanent business management must be followed. There must be permanency of administration, there must be far-sighted financing, there must be purposeful research. Research is more highly developed as the result of work of co-ordination accomplished in 1923. There has been no change in methods of financing and little advance toward agreement on sound principles of highway financing. The turnover in state highway administration was greater in 1923 than in any of many previous years. A more extended discussion of these occurrences will appear in our special highway issue to be published next week.

Generally there has been improvement in the technique of road construction. Construction procedure has become less erratic. Experienced contractors have worked out proved practices with standard equipment—the freak roadbuilding outfit so common a few years ago nearly disappeared in 1923. Another outstanding feature of the year was the stock-piling and storing of construction materials in winter ahead of the roadbuilding season, when transportation lines are not congested. In some states fully a third of all the stock for the summer's work was stored ahead. And in many states winter grading was purposefully encouraged by letting late fall contracts.

Design and research have gone marvelously ahead though the end in developing rational methods is far from being attained. Indeed the engineer has done his technical work well in all respects. Where criticism is deserved is in administration and finance. The situation in respect to both which was developed in 1923 would be discouraging except for the fact that it has aroused highway engineers to their danger and to a determination to clear it from the path of public roads improvement.

Cement and Concrete

THE increase in the use of concrete goes on. Last year the portland cement production probably totaled 135,000,000 bbl. as compared with the record of 115,000,000 the year before. This is pretty close to 100,000,000 cu.yd. of concrete, which by conservative estimate cost a billion dollars to place. Here is a major industry, but one singularly diverse and lacking unity of purpose or direction. Leaving aside say one-third of the concrete as being placed by farmers and house owners in minor use there still remains more than two-thirds of a billion dollars placed last year in permanent structures by many individuals and by many methods. Considering the diversity of manufacture the quality of the product is remarkably high, but it is by no means as high as it should be. The outstanding feature of the concrete art in the past few years has been the growing appreciation of the need for education in the art of making concrete. Gradually the gospel of better concrete is overcoming the self-satisfaction of its makers. The many and scattered series of tests are beginning to take on more than academic importance and their application to actual structures, both in the process of making and in the process of use, is beginning to take form.

The virus is working, too, in the cement industry. Committed to a campaign for the spread of information as to the best way to make concrete, the organized cement manufacturers—or at least some of them—are

beginning to realize that the time has come when there must be a more scientific study of cement, that possibly their very insistence on the elements other than the cement has forced the user to wonder about the cement itself. For the first time in years the standard specification for portland cement is under suspicion, not because any one has put forward any well defined change but because it is only human to think that perfection is not possible and that because a thing has been standardized is no reason to believe that it is perfect. The more forward looking cement manufacturers sense this spirit in the engineering world, a spirit most evident in the renewed activity in the American Society of Civil Engineers in the matter of cement research. Whether they will be able to overcome the tendency of the more conservative to let well enough alone remains to be seen. The year 1923 saw the rebirth of cement research.

The year, too, saw the beginning of interest in another kind of cement than portland. The so-called high alumina cements, whose most desirable characteristic is their quick hardening quality, are developing fast in Europe, especially in France. The obvious saving and convenience in being able to use a concrete a day or two after it has been placed, makes even a high price of secondary importance for some work while a possible high resistance to saline exposure is an obvious recommendation. One American cement company is experimenting with this new cement and the coming year should bring forth some interesting developments. There is no present possibility of the new product making any inroads on portland cement consumption but there is the chance that it will have a special use where need has long been felt.

Society Development

IN APRIL of last year the American Society of Civil Engineers for the third time rejected the federation idea as embodied in the Federated American Engineering Societies. Immediately thereafter it made advances which have resulted in the initiation of another form of co-operation with the three major engineering societies by way of a permanent organization of the presidents and secretaries of the four societies. It is too soon to evaluate either the permanent effect on the Federation of the final refusal of the civil engineers or the eventual success of the less rigid co-operation scheme. It cannot be said that the Federation has done either more or less since last April than it has done in the past; it remains as before to demonstrate that it can serve a useful purpose in the professional upbuilding of engineers or in improving the body politic or the public by the group interposition of the engineering mind.

The disposal of the Federation squabble seems to have reacted favorably on the American Society of Civil Engineers. It shows decided signs of rejuvenation both in the growing magnification of the local section and the concentration on technical thought through special groups. The program of the coming annual meeting, with its insistence on technical subjects, is a promise of a definite purpose worthy of commendation.

A remotely similar struggle marked the year in the American Association of Engineers. Various restless desires for decentralization of management, in part realized two or three years ago, broke out again last spring in a determined attempt to limit the authority of the central office in order to stimulate local chapter activities. Incidental to this change, the secretary was to be removed, as the official representative of the existing system of management. By the defeat of the decentralizationists the association seems to have put an end to internal strife for a time. The opportunity which peace gives for useful work and development comes at a good time, for after having lived through a severe crisis of decreasing membership the association is beginning to produce substantial results in its chosen field. Such things as formulation of principles of sound professional conduct and improvement of engineers' license legislation are well worth while as objects of association work, and if cessation of struggle brings continued advance along these lines it will be a welcome development.

Machinery and Materials

SEVERAL fairly definite trends in the field of machinery and material used by contractors and engineers are indicated on another page in *Engineering News-Record's* annual canvass of manufacturers. Of major importance was the definite action taken toward standardization. This movement manifested itself with regard to concrete mixers when makers and users agreed in joint conference to nine models for paving and building purposes. Substantial progress also was made in bringing about uniformity in the manufacture of wheelbarrows. Asphalt varieties, as determined by the penetration test, were reduced to ten, paving-brick varieties to six. Eliminations also were made in the sizes and types of face brick, hollow tile, and lumber.

Contractors of a generation ago relied mainly on steam as the power for operating their plants. Today the gasoline engine seems to be the preferred type of prime mover, although in localities where electric current is available this form of power is extensively employed. To keep step with the larger sizes and capacities of present-day construction machinery it has been necessary to install engines of greater horsepower than were common a few years ago. Gasoline-engine power is now being applied to practically every form of construction equipment, and the old prejudice against it, due to difficulty in starting during cold weather, has practically disappeared following mechanical improvements which remedy this fault.

There has been during the past twelve months a decided swing toward the use of tractor power for operating construction machinery. By this is not meant the employment of tractors for hauling road graders and other equipment—which, by the way, has shown a decided increase—but the incorporation of the tractor and the construction machine.

Efforts begun in 1922 to increase the mobility of construction plant were continued during 1923 and mountings on motor-truck chassis, both solid and pneumatic rubber-tired wheels, including four-wheeled carriages and two-wheeled trailers, have been supplied for a wide range of machines. In addition, to reduce the jolting and jarring during transit at speeds of 15 to 20 miles per hour, the cushioning effects of rubber tires have been supplemented by the use of spring suspension. For extremely heavy types of plant, such as steam shovels and large concrete paving mixers, low-platform four-wheeled trailers with rubber tires have been made available to contractors who wish to reduce to a minimum the time lost by their machinery during moves from one site to another.

Modern High-Tension Power Transmission Lines

Problems in the Design of Towers — Economy of Transmission at High Voltage Offsets Greater Construction Costs— Loads, Spacing of Towers, and Costs of Transmission Lines

BY WALTER DREYER
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THE COMPLETION in the year just past of two 220,000-volt long-distance transmission lines, the first of their kind in the world, is indicative of the rapid development that has taken place in the use of high voltages for the transmission of electrical energy. The successful achievement of such high voltage transmission has brought new problems and new fields of usefulness to civil as well as electrical engineers. The use of high voltages means larger and heavier conductors and higher and stronger transmission-line towers which require to be carefully designed in order to carry the load safely without undue cost. Moreover the introduction of high voltage transmission not only has made changes in the cost of power developments but has also made possible the development of power sites which heretofore have been impossible of economic development. All these items are of particular interest to civil engineers.

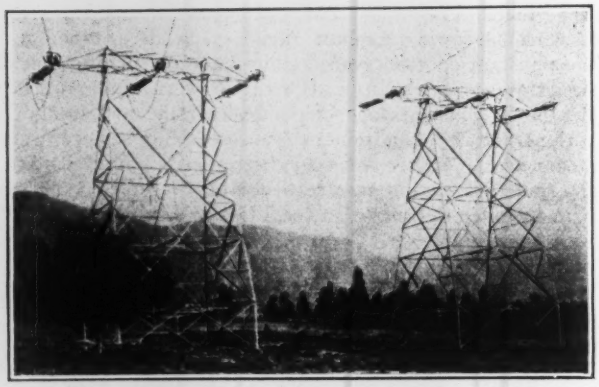

FIG. 1—ANGLE TOWERS ON 220,000-VOLT LINE

The purpose of this article is to set forth some of these general aspects of the electrical transmission situation as it stands today, avoiding those features which are of a character that concerns only the electrical engineer.

The history of the development in the use of higher voltages for transmitting electrical energy is shown graphically in Fig. 2. Practically the entire development of the art of transmission over long distances has been made within the last thirty-eight years. It began in Italy in 1886 with single-phase transmission at 2,000 volts, was followed in Germany in 1891 with three-phase transmission at 12,000 volts, and still later by a gradual development in three-phase transmission in western United States until in 1900 the line potential had reached 40,000 volts. In 1901, 60,000 volts was used on the Colgate-Oakland and Electra-Oakland lines in California, each about 150 miles long. In 1905, 72,000 volts was used on the Southern California Edison Co. line, and in 1908, 100,000 volts was adopted for the Las Plumas-Oakland line of the Great Western Power Co. In 1913 the Pacific Power and Light Co. (now Southern California Edison Co.) constructed the Big Creek-Los Angeles line 241 miles long, transmitting power at 150,000 volts, and this line held the high voltage record until 1922 when the 154,000-volt Japanese systems began to function. Then, also in 1922, the 165,000-volt Caribou line of the Great Western Power Co. was constructed, and finally the year 1923 introduces actual operation at 220,000 volts. The Southern California Edison Co. on May 6, 1923, energized one circuit of their 241-mile Big Creek-Eagle Rock line, and has since operated continuously at 220,000 volts. The Pacific Gas & Electric Co. on Nov. 16, 1923, energized one circuit of their 202-mile Pit River-Vaca-Dixon line at 220,000 volts and has likewise operated continuously since then at that voltage.

The foregoing cites only the high spots in the development and the use of high voltage transmission. It must not be inferred from this that the California companies, or even the American companies, hold a monopoly on the use of high voltages for their transmission lines. W. W. Lewis, of the General Electric Co., in *General Electric Review* for October, 1922, gave a list of 160 of the principal systems of the world operating at 66,000 volts or above. The geographical distribution of these systems is shown in Table I. From this it can readily be seen that the entire world is taking to the use of high voltages for transmission of energy.

Problems of Universal Interest to Engineers—It must not be felt that the problems of high tension transmission lie only in the field of the electrical engineer. It is true that the most involved technical problems—insulation, line regulation, the development of apparatus—must be solved by him, but unless there had been a simultaneous development in the field of the hydraulic engineer there would in all probability be no 220,000-volt lines in use today. Long-distance high

TABLE I—GEOGRAPHICAL DISTRIBUTION OF 160 PRINCIPAL HIGH-VOLTAGE SYSTEMS

	Voltage						
Country	66,000 to 77,000	80,000 to 90,000	100,000 to 115,000	120,000 to 132,000	140,000 to 154,000	165,000	220,000
Australia	..	..	..	1	..	..	
Brazil	..	3	..	..	..	..	
Canada	1	2	2	1	..	..	
Chile	..	..	3	..	..	..	
France	..	..	..	2	..	..	
Germany	..	..	1	..	..	..	
India	..	1	2	..	..	..	
Italy	3	1	..	..	..	..	
Japan	3	..	1	..	6	..	
Mexico	1	1	3	..	..	..	
Portugal	..	..	..	1	..	..	
Spain	2	1	1	3	..	..	
Sweden	3	1	1	1	..	..	
Tasmania	..	1	..	..	..	..	
United States	45	10	29	14	5	1	2
Victoria, S. A.	..	1	..	..	..	..	
Total	58	22	43	23	11	1	2

voltage transmission requires large generating units to handle the line, and this means that the designers of prime movers—either hydraulic or steam—play an important part in this work.

There is also work for the structural engineer in the design and construction of the towers supporting the line. The metallurgist has contributed his bit by developing a steel which has a very high yield point—45,000 lb. per square inch—and still retains its ductility. This has made it possible to design the towers of lighter sections, thus helping materially in the problems of transportation and erection.

Advantages of High Voltage—In any country, state or community which is enjoying continual industrial development, there is required an ever increasing amount of power. At first the readily available sources are developed, but as the demand outgrows this supply, it is necessary to seek farther for new sources of power.

The losses in transmitting energy vary approximately as the distance it is transmitted and inversely as the square of the voltage used. As the distances increase it becomes necessary to increase the voltage in order to keep these losses down. Therefore, as it becomes necessary to go further to get power, it also becomes necessary to increase the voltage at which it is transmitted. At the present stage in the development of power it has become necessary for at least three companies to bring large blocks of power for distances 200 miles or more, and this has resulted in the adoption by one of 165,000 volts and by the other two of 220,000 volts, in order to bring this energy to the market at the lowest cost consistent with conservative design. It might well be said then that high voltages have been forced upon us because of the necessity of transmitting at a reasonable cost large blocks of power over great distances.

The two California companies now operating 220,000-volt lines had different reasons for adopting this record breaking line potential; each had an entirely different specific problem and each analyzed it from the economic standpoint in order to reach a decision economically sound.

The Pacific Gas & Electric Co. was just beginning to develop the Pit River with potential power resources of 500,000 kva., all to be brought in in a period of about fifteen years. The initial installation consists of two circuits, 60 miles on single circuit towers, and the remaining 141.5 miles on double circuit towers. The initial developments on the river consisted of Hat Creek No. 1, Hat Creek No. 2, and Pit River No. 1 plants, with a total installed capacity of 95,000 kva. The reasons for using 220,000 volts in delivering this power, as cited by J. P. Jollyman, in charge of hydro-electric and transmission engineering for the company, were as follows:

(1) It was decided that 220,000 volts represented the greatest advance of proved practice that could be considered conservative.

(2) The amount of power which one circuit could transmit fitted the development program very nicely.

(3) It was felt that a spare circuit for at least the average load should be had at all times. A double circuit would therefore provide a spare circuit for the initial development and two double circuit lines would give a spare circuit for the ultimate development.

(4) The use of a higher voltage would not have been conservative nor would it have given a number of circuits sufficient to insure reliable and convenient operation.

(5) The size of generating units required to handle the charging current for higher voltages would have been greater than desirable.

The problem confronting the Southern California Edison Co. was somewhat different. In 1917 they had acquired the Pacific Light & Power Co. with its Big Creek system. The original line was designed for 150,000 volts, had a capacity of about 150,000 hp., and was fully loaded in 1922. The 1923 program due to the abnormal growth of load in southern California called for additional hydro-electric power on Big Creek of 22,000 hp. at Big Creek No. 1 and 105,000 hp. at Big Creek No. 3. It was therefore necessary either to construct a duplicate set of towers, giving a total of four circuits for operation at the same voltage, or to reconstruct the existing line for operation at 220,000 volts, thereby practically doubling its capacity. The latter

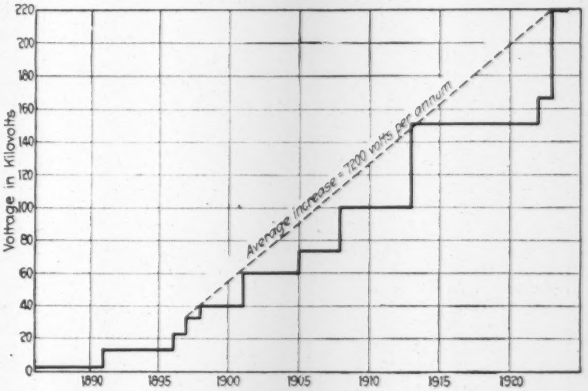

FIG. 2—DEVELOPMENT OF HIGHER VOLTAGES FOR TRANSMISSION

plan resulting in a cost $7,000,000 less than the former and was therefore adopted.

The approximate kilowatt capacity and cost per mile of transmission lines supported on steel structures with concrete foundations is given below:

TABLE II—COST AND CAPACITY OF TRANSMISSION LINES

Voltage	Type of Tower	Cost per Mile	Capacity (kw.)
220,000	Double circuit	$30,000	240,000
220,000	Single circuit	20,000	120,000
110,000	Double circuit	15,000	60,000
110,000	Single circuit	10,000	30,000

Some of the effects of higher voltages on structural and mechanical problems with a brief but comprehensive discussion of each are presented in the following:

1. *Conductors and Conductor Tension*—The use of 220,000 volts means that the conductor required to keep down the corona loss is approximately one inch in diameter. Cables of this size have great strength, and if, as is common practice, they are stressed to the elastic limit under maximum loading, the loads applied to dead-end insulator strings and to the towers are far in excess of those with which the tower designer of ten years ago had to cope. The mechanical characteristics of the conductors used on the 220,000-volt systems now in service are given in Table III.

The use of the higher tension by the Edison Co. has made it necessary to resort to double insulator strings connected at each end by yokes designed to distribute the load equally to each string. The lower tension used

by the Pacific Gas & Electric Co. permits the use of a single string of extra strength insulators for dead ends.

2. *Economical Span*—For 110,000-volt lines under average conditions the economical span usually worked out to be approximately 800 ft. and this spacing was adopted for many such lines. With the use of the 220,000-volt line, requiring heavier towers, more costly foundations and far more expensive insulators, the economical span will probably be in excess of 1,000 ft. The economic span for both the Eagle Rock-Laguna Bell line and the Pit River double circuit line is approximately 1,200 ft. The towers of the former are designed for a 1,250-ft. spacing while those of the latter were maintained at 800 ft. in order to reduce the working load on the suspension strings.

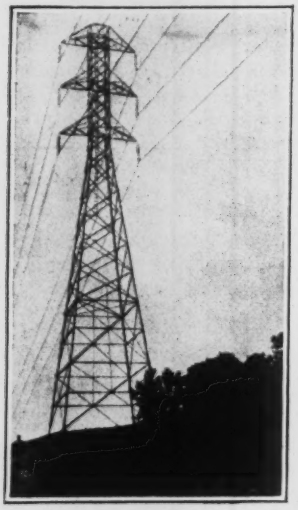

FIG. 3—TYPICAL DOUBLE-CIRCUIT TOWER ON 220,000-VOLT LINE

3. *Economical Tension in Conductor*—Investigations made by the engineers of the Pacific Gas & Electric Co. showed that a maximum tension of 17,000 lb. per square inch in the copper resulted in a saving of about 20 per cent in the cost of towers and foundations over the cost for a maximum stress equal to the elastic limit. It is certain that some such point of maximum economy also exists for steel reinforced aluminum wire. With the heavier wires used 20 per cent saving represents a considerable amount of money (in the case of the Pit River double circuit towers about $1,200 per mile). Investigations to determine the "economic stringing stress" are therefore easily justified.

4. *Types of Towers in General Use*—In general, three types of standard towers are in use, namely, the dead-end tower, anchor tower and straight-line type.

The dead-end tower, as its name implies, is designed to resist the breaking of all wires in one span, with the insulator supports in the dead-end position. This tower is also used for turning angles in the line.

The anchor tower is also designed to resist the breaking of all wires in one span, with the insulator supports, however, in vertical suspension, giving a reduced load on the tower. This type of tower is placed in the line at intervals of every few miles (every six miles on the Pit River tower line) to prevent progressive failures in the remote possibility of the failure of a standard straight-line type.

The standard straight-line type is usually designed to resist the breaking of one or two wires on single circuit towers or one, two or three wires on double circuit towers, the insulator supports in either case being in the vertically suspended position, giving a load somewhat less than the maximum conductor tension. It has been the experience of the Pacific Gas & Electric Co. on their double circuit towers (the wires of one circuit being in a vertical plane) that the breaking of the top wire will often bring down all three. It has therefore become our practice to design our double circuit towers to withstand the loads due to the breakage of the three wires of one circuit.

5. *Effect on Tower Design*—The tower supports became larger and heavier for two reasons, first because of the wider spacing of conductors and greater clearance required for the higher voltage, and second, because of the heavier loads due to the larger conductors.

TABLE III—DATA ON CONDUCTORS NOW CARRYING 220,000 VOLTS

Type of Cable:	Southern California Edison Company Big Creek to Eagle Rock Built 1912 Aluminum (Steel core)	Southern California Edison Company Eagle Rock to Laguna Bell Built 1922 Aluminum (Steel core)	Pacific Gas & Electric Company Pitt No. 1 to Round Mt. Aluminum (Steel core)	Pacific Gas & Electric Company Round Mt. to Vaca-Dixon Copper
Circular mils. Copper				500,000
Circular mils. Aluminum	605,000	666,600	518,000	
Circular mils. Steel	78,500	86,100	234,000	
Total	683,500	752,700	752,000	500,000
No. strands copper				49
No. strands aluminum	54	54	42	
No. strands steel	7	7	19	
Wt. per ft. (lb.)	0.77	0.86	1.12	1.54
Diameter (in.)	0.96	1.00	1.00	0.91
Total area (sq.in.)	0.537	0.59	0.59	0.393
Ultimate strength (lb.)	18,000	23,430	28,100	21,600
Elastic limit (lb.)	10,200	16,180	17,160	11,000
Max. working stress (lb.)	9,500	12,000	7,000	7,000

The heavier loads on the tower make necessary a closer investigation of stresses in the details of the tower, particularly in the eccentricity of the connections of web members. The analysis for torsional stresses in the standard square towers is simple and presents no new problem. For single circuit towers, however, it was usually customary to make the conservative assumption that the torsional stresses were carried entirely in the two faces parallel to the line. With the heavier loads now in use, considerable economy can be effected by making a more rigid analysis carrying the torsional shears into the four faces of the tower.

6. *Tower Foundations*—The standard foundation construction is either of steel or concrete. Although some companies use concrete footings as standard construction, it is the general practice to use steel footings for the standard towers with concrete footings at angles and other critical points.

The heavier loading of the 220,000-volt towers makes necessary a more careful analysis of the foundations in order to take care of the large horizontal force applied at the top of the footing. This has forced the use of reinforcing steel in the stems of the concrete footings for standard towers, and a complete reinforced footing—both stem and pad—for anchor and angle towers. With the lighter loads formerly used the flexural strength of the plain concrete (about 20 per cent of the compressive strength) was sufficient and it was not necessary to reinforce the concrete.

Wood poles with clearances designed for 220,000 volts are in use on one circuit of the Pit River line between Hat Creek and Cottonwood. The poles have an average spacing of 500 ft. and the line is protected from any progressive failure by anchor towers placed every two miles. The wood pole line was constructed because delivery of towers could not be obtained in time for the bringing in of the two Hat Creek plants in 1921. When the second circuit was completed in 1923 additional towers were placed at all critical points in the pole line. The standard pole structure is made up of two poles, 16 ft. apart, with a crossarm 33 ft. long placed 3½ ft. below the top of the poles.

State and National Duty in Conservation of Water Resources

A New Stream Policy: Government Planning and Control of Water Storage

By C. E. Grunsky
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WITH the growth of the country's population comes the realization that there is a limit to our water resources. Their fullest possible utilization is desirable. The conflicting interests of water users must ultimately be brought into proper relation to each other. To this end the stream flow requires regulation by storage reservoirs and related works, and the regulation should be such that all water requirements receive due consideration. The flood control function of reservoirs, in some cases, must not be overlooked. It is essential, therefore, that as a general principle the regulation of stream flow should not pass into the hands of private or local interests, but should be kept or should ultimately be brought under government control.

Government Control for Conservation—It seems self-evident that the United States should regulate and control the flow of interstate and international streams, and that the several states should regulate and control the streams whose watersheds are entirely within the limits of a single state, to the end that the waters now flowing to waste be made available for beneficial use to the maximum extent found to be economically feasible. Rights already granted in the waters of the country, developments already made, and ownerships established to important reservoir sites, will in many cases interfere with any adequate ultimate regulation scheme. Moreover, the granting of additional rights to individuals and to organizations both public and private, without restrictions as to use of reservoir sites, still goes on. The longer this continues, the more difficult will it be to enforce a sane policy of water conservation and the less complete and effective will be the government control when exercised.

It is not only desirable but also timely that the United States be committed to this policy, and that in the case of the interstate or international stream the regulation of its flow should be a government function, while in the case of streams wholly within a single state the state should provide storage and diversion works necessary to obtain from the water the greatest good to the greatest number. The adoption of such a policy, however, should be subject to the understanding that there is no intention to interfere with or to delay the development and utilization of water resources by private enterprises and private capital whenever such development fits into the comprehensive plan and does not deprive government of the control needed to protect present and prospective adverse interests. The private development, made perhaps with but a single purpose in view, but conformably to the superior comprehensive plan, would in any such case require assurance that all parties who benefit from the investment of private funds will ultimately make full contribution to the cost.

Reclamation a Separate Problem—Such a water conservation policy as here suggested should be considered entirely apart from the government activities which have to do with the operation of public utilities, or with reclamation of barren areas of land. If, as time goes on, it shall be found desirable to further increase, at government expense, or with government aid, the area of arable land, by irrigating the desert, or by draining swamps or by pulling stumps on cut-over lands, these propositions should be considered on their merits and apart from the more vital need of declaring a policy in the matter of the regulation of stream flow.

To some extent the United States government has already been committed to the reclamation of certain arid and semi-arid areas. It now appears that in many cases the attempt to go beyond the wholesaling of water was premature. Serious consideration must now be given not alone to limiting new activities along these lines, but also to the wisdom of continuing the indirect appropriations for reclamation purposes and of continuing the indirect bonus to the landowner which results from the "repayment without interest" provision in the Reclamation Act.

Stream Planning Required—It is timely, as already stated, that suitable provision be made by the United States and by the several states for the machinery and funds to carry out a water conservation program. The engineering and economic study of each project, or of any project unit, should then go hand-in-hand. As a rule only such projects would be sanctioned and approved for construction as are economically sound.

By the adoption of a conservation program of this kind the United States and more particularly the several states would soon find themselves in the position of wholesalers of the stream's output of water and power. Storage and main diversion works would be built wherever and whenever the local demand justifies the construction. The municipality, the irrigation district, and the power company would be saved the outlay of capital required to provide storage works. In many cases the reservoir would fill the requirements of more than one user, the water used for power would in part at least be still available for the irrigator, for municipal supplies, and possibly to keep the waters of the stream at a navigable stage.

That operation under such a policy is practicable and can be made successful is perhaps best illustrated by reference to the achievements of the Metropolitan Water Board of Massachusetts. This board was organized to construct works and supply water at wholesale to Boston and neighboring towns. The state placed somewhat more than $40,000,000 at the disposal of the board. Storage reservoirs and main conduits were then constructed to deliver the water whose distribution is not taken charge of by each city or town. The entire expense of operation including interest charges and also sinking fund requirements has been and is being successfully met out of the receipts for the water which is being delivered to Boston and 27 or 28 communities.

Its Influence on Reclamation—Under the United States Reclamation Act the policy has been adopted of delivering irrigation water to each landowner. To the extent of the cost of accomplishing this delivery and of securing to him a water right he gets, in effect at least, a long-time loan free from any interest charge. This has resulted in the extension of irrigation to areas whose reclamation would not have been considered a sound business proposition if the landowner had to meet the full cost of the required works. Whether this is a wise provision may well be questioned. Would it not be better to consider untimely every reclamation

project which will not stand the necessary cost of preparing the land and distributing water, as well as a reasonable wholesale charge for the water when delivered to it at one or more central points?

The adoption of a policy as here outlined would go far toward a restriction of reclamation enterprises to those which are timely. The restriction of government activities to the construction of works which are intended to regulate the stream flow would discourage irrigation enterprises which are not fundamentally sound. The government would not be committed to the supervision of land settlement and farming activities, except, of course, where land settlement is made the special feature of an enterprise. Above all, control by the government over the enterprise for the conservation of water (storage reservoirs) would gradually be secured with the least possible interference with vested rights.

Elements of the City Traffic Problem Reviewed

Problem Composed of Many Complex Factors—Standardized Recommendations Inadequate — Representative Examples Cited—Technical Elements Enumerated—Solution Indicated

By J. Rowland Bibbins
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IT SEEMS high time for those concerned in the serious study of city and transportation development to make a new appraisal of present conditions and future needs; for the conflict of interest of various groups of our people using the public streets has become a veritable battle for supremacy. Traffic has become a regional as well as a local problem, and future growth must be met more frankly and scientifically than the past. "Traffic" is like the "mumps"—simply a name, a disease. It is a result, not a cause. The disease, after accurate diagnosis, can be treated. But a cure requires scientific study, often a major surgical operation and eventually a large bill for repairs. The longer the delay, the larger the bill. There is no cure-all, no panacea, no patent medicine at so much per dose. Yet this method is being applied daily, most often as a result of the vociferations of this or that improvement association possessing the most stentorian vocal powers.

The editor of an outstanding American journal of vision recently wrote: "At present, most cities are floundering around without one clear conception of the real problem among a score of them." This emphasizes the writer's view-point. Layman committees are being appointed in every city, dignified by the names of busy executives who are skilled in particular lines but who do not and cannot give the time needed to develop the basic facts or synthesize them into an adequate plan of action. He who runs may read the standardized recommendations: "education of the public, increasing the police force, one-way streets, block signals and exclusion of the car lines from the down-town district *or* no-parking of autos down-town—depending upon which way the balance of the power runs in the committee. This method of attack will never reach the heart of the traffic problem. How could it be expected to do so?

On the other hand, if the organized citizenship of our cities could be brought to a real understanding of the aggregate tens of billions in annual losses; or the insurance companies, of the tremendous savings possible in decreasing loss of life and property; or the motor industry, of the equally tremendous obstruction to the normal growth of its business, it might be possible to institute in this country a hopeful movement for the basic study of the whole situation, marshaling first the underlying facts, then producing a scientific program of immediate correction and future development which would go to the real heart of the question and give some assurance that the future is not to prove the utter failure of well organized, efficient and contented community life. The cost of such an inquiry would be infinitesimal, compared to the benefits.

Statement of the problem—The traffic problem is one of transportation and terminals. It runs precisely parallel to railroad and transit operations in most respects. The dynamics are the same. But in its civic aspects it is a puzzling complex of many forces: tradition, precedent, habit of motorists and pedestrian, unscientific planning of roadways, undue concentration of business along Main Street or around the Town Pump, the pernicious influence of high land values, regional competition between retail streets or districts, the overemphasis of the economy in centralization, the underemphasis of the real value of maximum distribution of peoples, commerce and industry, the elusive effects of natural or artificial barriers to the well-ordered expansion of the city and its business district, the ineffective administration of police control due to the interference of special interests, the laxity and delay in court procedure which places a premium upon evasion, and other determinants of like character.

This problem is as broad as city life and calls for the widest experience and judgment in civic and technical affairs. To expect "verboten" legislation, no-parking signs, one-way streets or artistic block signal towers to cure such a deep-seated malady as city congestion is beyond reason. Each has its place in any plan of action, but while many sincere efforts have been put forth, they have rarely been based upon a proper perspective of the tremendous problem of city growth nor made any reasonable attempt to co-ordinate traffic and transportation agencies contributing to or affected by traffic congestion or to build up an authentic fabric of fact which must be the primary datum plane of such a perspective.

Let us consider some representative problems:

1. *An industrial city* nearing 500,000 inhabitants with an almost ideal basic city plan both for the central district and outside, but even with 90 to 120-ft. streets suffering from grievous congestion. After a detailed traffic survey the writer recently found that, with some 40 street outlets from the central district in all directions, the actual efficiency of use of the roadways was barely 25 per cent of what should be practicable, even assuming full parking throughout the district along both curbs. In this city, the aggregate evening peak

motor movement outbound was found to exceed two-thirds of the total number of street railway *passengers* outbound. During the entire day the motor movement in this business district actually totaled one movement for every 25 people within the city, and nearly three movements per day for every vehicle registered in the district—truly astonishing facts.

2. *A residential metropolis* nearing a million people with only one main thoroughfare through the business section and that needed not only for a street railway terminal trunk line, but also for crosstown heavy trucking between opposite railroad centers and wharves and warehouses. Nearly 400,000 people here depend upon four or five car lines, the principal line having to operate in a 60-ft. street with a 36-ft. roadway—four line traffic, in which practically all traffic uses the car tracks especially during winter when from 10 to 16 ft. of aggregate snowfall is recorded.

3. *A quiet little home suburb* of twenty years ago, 7 miles from the center of the city located upon the one and only through radial thoroughfare, now grown into an industrial beehive with the largest single factory in the world debouching 70,000 employees per day and 38,000 in one shift largely at two points. But no adequate relief arteries have been provided, nor grade separations, traffic underpasses, covered terminal stations, turnstile pre-payment compounds, loading platforms or various other possible means of relief.

Technical Elements—An analysis, that is apparent from what has been said, gives the following elements of the problem:

1. Growth factors, past and present, determined from various dependable indices, with a scientific forecast of the future.

2. Street and highway plan, capacity and design adequate not only for present needs but reconditioned to provide adequate capacity for future needs in so far as the type and volume of future traffic can be predicted. This includes the questions of paving, crowning, curbing, intersections, sidewalks, parking, set-backs, segregation of streets for different purposes, cutoffs, crosstown and by-pass streets, speedways, boulevards, diagonals, and parallel diagonals.

3. Local transportation, track capacity, routing, terminals, loading and stopping points, track centers, clearance curves, type of construction, interim rapid transit, ultimate rapid transit, buses, transfer facilities and, indirectly, service standards. The key to this situation is track capacity dictated by the policeman's signal, the headway limitation of the heaviest loading point and the capacity of the most congested crossing.

4. Traffic organization and control, vehicle and pedestrian, covering the appropriate type of signal system, the personal equation of the traffic officer, education of the traffic force, segregation of traffic, by-passing of unessential traffic, reasonable limitation of parking, provision of down-town long-time storage, pedestrian under-passes, directional traffic control in parallel lanes, marking of traffic ways, safety islands and loading platforms, rules of the road, methods of checking infractions, standards of operation for motors, definite routing of truck movement, examination and education of motor drivers, control of building obstructions in the street, time restriction on street openings, co-operation of public agencies.

5. Railroads and terminals, provision for special needs, economic location of terminals, sequence and design of grade separations, economic location of belt lines and clearing yards to reduce down-town terminal traffic, motor freight delivery and interchange, passenger station location and service, development of port and terminals to segregate city and harbor freight, development of strategic railroad entrances.

6. Interurban development, entrances, terminals, freight depots, merging them into the rapid transit plan, co-ordination of suburban and feeder bus system, motor freight delivery.

7. Adjustment to the broad city or district plan and the general public welfare—special needs of the office, wholesale, retail, warehouse and industrial districts, adequate distribution of the residents, effect upon the funding power of the city for public improvements as measured by its increasing revenues of taxation upon private property, and the proper program of development incorporating these various factors.

What to Do About It—No rule can possibly fit all situations, but there are certain universal principles:

1. Get after the basic facts on traffic movements, distribution, growth, and needs, and determine where the main difficulties exist and what corrections must be made—now, near future and ultimate.

2. Schedule and budget a definite street reconditioning program for five years ahead to develop reasonably soon, on the essential arteries and by-pass streets, the full roadway capacity needed.

3. Survey even more intensively the physical and economic limitations of the central business district as a separate terminal problem embracing all of these transportation elements.

4. Organize for the development of a comprehensive district transportation plan broadly conceived, not necessarily in great detail, but integrating the various conflicting interests for the good of the whole community.

5. Plan now for a city of double the present size, without stopping to quarrel at just what date that event will take place. It will be sure to come too soon.

6. Entrust this transportation plan to technical leadership or a commission whose personnel embraces the special qualifications and experience appropriate to the difficulty of the task.

7. Provide ample funds for field and staff work. Such an enterprise is worthy of more than niggardly financing. The work will be largely without precedent and will return infinite dividends to any community.

8. Make the transportation plan, above all, a continuing development linked in with the public works program and considered in the same category of construction and finance.

Intimate and sympathetic co-operation of the various commercial and civic bodies is essential to maximum progress after the basis of fact has been laid and a tentative program and plan have been drafted. For even the most skilled commission can scarcely hope to fathom the full depths of a city's inner consciousness without such invaluable aid.

The transportation plan should not be subordinated to any other phase of the city plan. It is not a detail to be passed over with an elusive brush; it is fundamental to a city's life. But there is equal reason, nevertheless, to conserve to the maximum the æsthetic and spiritual values of a properly conceived city plan.

Improvement Is Present Keynote of American Railroads

Double-Tracking, Grade Reduction and Line Revision for Efficiency in Handling Heavy Traffic—Grade Separation in Cities—Enlarging Yards, Terminals and Passing Tracks

By E. E. R. Tratman
Associate Editor, *Engineering News-Record*

INTENSIVE improvement of existing main-line railroads in order to secure increased efficiency and economy in the handling of their traffic has been the conspicuous feature of railroad development during the past few years, particularly in the mid-west and western sections. In fact, work of this kind has practically superseded the construction of extensions and branches to develop additional traffic from new territory, for under the present exceptional conditions the companies have bent their energies vigorously to the improvement of the existing railway system as a transportation machine. It is probable that this will be the ruling policy for some years to come.

Principal among the causes leading to this policy of improvement are the following: (1) The enormous increase in traffic during recent years; (2) the unfavorable financial conditions; (3) the rather general unfriendly attitude of the public, which it is desirable to counteract; (4) the new regulations as to wages and working hours of employees, under which it becomes important to have trains complete their runs within very definite time limits, in order to avoid overtime charges. Economy in freight transportation cost is related closely to the concentration of traffic in heavy trains, requiring the provision of powerful locomotives and the taking of special care to avoid the increased liability to detentions which attend the movement of such trains. Heavier trains mean longer trains and the consequent lengthening of yard tracks and passing sidings, and, frequently, grade revision.

Improvement works which are undertaken to expedite train movements and to promote the economic handling of traffic include the following: (1) Double-tracking, to increase traffic capacity and reduce delays; (2) grade reduction and line revision, often planned in connection with double-tracking; (3) extension of passing tracks to accommodate longer trains; (4) freight yard construction and enlargement; (5) engine terminals and coaling and water stations of improved design and located in accordance with traffic requirements; (6) belt lines to keep through freight traffic clear of large cities; (7) grade separation in cities and on busy highways.

Double-Tracking

Practically all American railroads have been built as single-track lines, and on many main-line divisions the traffic now taxes their capacity, causing congestion and delay in the operation of fast and slow trains in both directions, even with a liberal provision of passing sidings. One of the most obvious methods of relief is to provide a second track in order to eliminate opposing movements. This saves much stopping of trains, perhaps at unfavorable points, with consequent damage to track, equipment and freight. Passing sidings will still be required to permit slow trains to keep clear of fast trains which overtake them. For 1923, twelve railroads alone planned an aggregate expenditure of over $30,000,000 for double-tracking.

The mileage of second track has increased from 8 per cent of the total route mileage in 1908 to 10 per cent in 1914 and 16 per cent in 1922. Allowing for branches, on which double-tracking is not a consideration, it may be estimated that double-track does not exceed 22 per cent of main-line mileage. Some of the eastern roads have as much as 66 per cent of second track and the eastern district has 37 per cent of its total mileage equipped with multiple tracks.

Traffic Capacity—What is the capacity of a single-track railroad? This is a question which arises naturally in connection with double-tracking. In general the limit is put at fifty trains daily. This is merely an approximation, since the capacity in any case is affected by such factors as ruling grades, character of profile, proportions of passenger and freight trains and local operating conditions. In "Railroad Freight Transportation" L. F. Loree, president of the Delaware & Hudson Co., presents the conclusion that the capacity may be taken as sixty trains daily (of which 25 per cent are passenger trains), but that double-tracking should be begun when forty trains daily are reached.

Double-Track Conditions—In some cases double-tracking is needed particularly near large cities, where traffic concentrates. An example is the recent 20-mile stretch of the Pere Marquette R.R. from Detroit to Plymouth, at which latter point two important divisions join the main line. In other cases the work is required on relatively short stretches, where traffic conditions or heavy grades tend to cause congestion. Such improvements are usually planned as part of a program for more extensive double-tracking at some future time.

There has been undertaken, however, a large amount of long continuous stretches of main line in order to expedite movements, reduce siding delays, increase safety and effect economy in operating expense. A notable example is the Santa Fe, which is double-tracking the 750 miles between Albuquerque, N. M., and Barstow, Calif. The Southern Pacific is double-tracking a considerable length of the Central Pacific line, and the Big Four some of its busiest main lines.

Grade Reduction and Relocation

Since practically all the older railroads were built either as pioneer lines or for a relatively light traffic (even near large cities), and with low construction cost as a primary consideration, it is only to be expected that the original grades and profiles will rarely be favorable to the efficient or economic handling of the heavy traffic and heavy trainloads of today. Under these modern operating conditions, therefore, and in view of the necessity of giving greater attention to operating economics, there are many cases where extensive expenditures are warranted in reducing grades and curvature and securing a more advantageous profile. With lower grades, a given traffic can be handled in fewer trains, thus increasing the capacity of the line as well as reducing transportation expenses. But the fewer trains

will be heavier and longer, which factors enter into the study of the case. The engineer has then a large opportunity to modify and improve the original location or even to relocate stretches of line. Although work of this kind has been under way for many years, it is increasing in extent and in importance.

It is sometimes assumed that 0.3 per cent is the economic limit for grade reduction, but special conditions may warrant a still lower limit. Thus on the Hocking Valley Ry. it was found economical to reduce the grades to a maximum of 0.2 per cent instead of 0.3 per cent. In many cases the advantage of improvements of this kind lies in the ability to handle through trains of standard tonnage rating, where now these trains have either to be divided or to be assisted by pusher engines on account of heavy grades. While pusher grades may not always be eliminated by relocation, the profile may be so modified as to reduce materially the trouble and expense of their operation. An example of this is on the Oregon Short Line, near Glenns Ferry, Idaho, where there is a deep sag in the grade line. It was found that prohibitive cost would be incurred in reducing two pusher grades to the normal maximum for tonnage trains, but they were shortened and rearranged for economical pusher service with tonnage trains.

Grade reduction is very generally undertaken where the ruling grades limit the handling of trains of standard tonnage rating, or where the new profile will enable a material increase to be made in the trainloads of an operating division. For example, the reduction of maximum grade from 0.8 to 0.3 per cent on the Cleveland-Indianapolis line of the Big Four Ry. enabled the train load to be increased from 2,200 to 4,000 tons. On a line of the Louisville & Nashville Ry. reduction of the ruling grade from 1.25 to 0.65 per cent has enabled the trainload to be increased 60 per cent, or from 3,150 to 5,300 tons, with material lowering of operating expenses.

On the Northern Pacific Ry. west of Bozeman, Mont., it was found economical to increase distance from 24 to 33 miles in order to reduce the grade from 0.8 to 0.4 per cent. In this case the change increased the traffic capacity by enabling standard trains of 2,375 tons to be operated over the division, instead of being reduced to 1,567 tons for a short distance. In addition, the extra trains to handle the excess tonnage were eliminated. Grade reduction carried out by the Nashville, Chattanooga & St. Louis Ry. in 1922-1923 enabled 200 tons to be added to the train rating, which in turn necessitated an increased length of passing sidings.

Double-Tracking and Grade Reduction

At first sight the work of double-tracking might appear to be a fairly simple and inexpensive proposition of widening cuts and fills and extending or rebuilding bridges, although under the inherent difficulties of construction work on operated lines of railroad. In reality, the proposition is usually much more complicated and expensive, since grade reduction and improvement of profile and location usually enter into consideration, for reasons noted already. In considering a policy of double-tracking, therefore, the engineer realizes at once the opportunity for economic relocation, with grade and line revision, to produce a profile more favorable for modern traffic conditions. Even in prairie or rolling country these opportunities present themselves, while in rough country they are more numerous.

The engineer has a problem then in deciding what method is best adapted to the requirements: (1) He may improve and double-track the present line; (2) if the original line is mainly favorable to traffic in one direction he may build the second track as a separate single-track line favorable for movements in the opposite direction; or (3) he may build new stretches of double-track, the original line being abandoned or perhaps retained for local service. In the majority of cases, revision goes hand-in-hand with double-tracking. For example, in the 750-mile stretch of the Santa Fe Ry., noted above, the maximum grades are being reduced from 1.82 to 1.42 per cent and there is considerable relocation.

An example of these problems is the work on the St. Louis-San Francisco Ry., which has increased its double-track from 59 miles in 1917 to 111 miles in 1923, with ten miles more under way. In the same period its length of line was increased only about eighty miles, or to a total of 5,246 miles. Most of the double-tracking has been on stretches of line where trains tend to meet and cause congestion. It has been introduced also at points where heavy grades opposed traffic in one direction, the new second track being then built on an independent location to give easy grades. Thus, a single-track cutoff with 1 per cent maximum grade for eastbound traffic was built between Lebanon and Sleeper, Mo., where the original line had a grade of 1.6 per cent against eastbound traffic but was favorable to westbound traffic. This road has also double-tracked the 42 miles from Kansas City to Paola for the reason that the Missouri-Kansas-Texas R.R. is a tenant and the combined traffic of the two roads could not be handled efficiently on a single track. But here again grade reduction was introduced, the original maximum grade of 0.75 per cent being reduced to 0.5 per cent.

The operating economy of work of this kind is illustrated by a proposed 28-mile piece of second track on the Northern Pacific Ry. which will complete a 288-mile stretch from St. Paul and is so located as to reduce the 0.5 per cent ruling grade in its operating district to 0.3 and 0.2 per cent for westbound and eastbound movements respectively. The consequent saving in time now lost by detentions is estimated as equivalent to 6 per cent on the investment. Similarly a 16-mile piece of second track now under construction on the Chicago, Burlington & Quincy R.R., in Illinois, will give a maximum grade of 0.25 per cent and eliminate a 3-mile pusher grade of 1.25 per cent opposing the heavier northbound trains. For the lighter southbound movement the present line is sufficiently favorable.

Joint Double-Track Lines—Reference may be made to several cases in which two parallel single-track railways are operated jointly as sections of double-track, under mutual agreement. In most cases such operation is limited to lengths of ten to twenty miles, but this method is said to have been adopted for a 200-mile stretch of the Southern Pacific and the Western Pacific.

Multiple Tracks—Not very much has been done in increasing the mileage of third and fourth main tracks, which are advantageous for busy lines near large cities. One of the most extensive works of this kind is on the Illinois Central R.R. out of Chicago, where both widening and grade reduction have been carried out providing for third and fourth tracks. The Chicago & Northwestern Ry. is also extending a third track for thirty miles out from Chicago on its line to Omaha.

Passing Sidings

A prominent activity in present railroad improvement is the extension and rearrangement of passing sidings to expedite train movements in general and particularly to avoid the delay in handling tonnage trains at meeting points where the sidings are of inadequate length, requiring much sawing to and fro. Many of the old sidings were built for trains of 40 to 60 cars and were located arbitrarily or for operating conditions very different from those which obtain today. Consequently valuable time is lost in many cases in handling modern trains of 80 to 100 cars, due to both inadequate length and unfavorable position of sidings.

One particular point which may be mentioned is the steady, but still slow, adoption of remote control of siding switches to eliminate delays. In ordinary practice, a train which is to take the siding must stop in advance while a brakeman goes ahead to open the switch. All stopping and starting of heavy trains is costly, both in time and in wear or damage to track and rolling stock equipment. With remote control, the operator at a station or interlocking tower can open a switch a mile or more distant, under orders from the dispatcher. A signal automatically indicates to the engineman that the switch is open and he need not stop. In this way the train can be kept moving until it comes to position in the siding.

Other Improvements

Various additional improvements to facilitate the prompt and economic handling of trains may be noted.

Freight Yards—Here, as in passing sidings, many old yards require the lengthening of tracks to accommodate the longer modern trains. Additional tracks and other facilities are also needed for the heavier traffic. In some cases it is found more economical to build a new yard than to enlarge an old one, examples of this being the Denison yard of the Missouri-Kansas-Texas R.R. and the Selkirk yard of the New York Central at Albany. Notable yard work of 1923 includes the practical completion of the Niles yard on the Michigan Central R.R., the new Detroit yard of the Pennsylvania R.R., the preliminary work for the great Markham terminal yard of the Illinois Central R.R., at Chicago, and the major part of the New York Central yard.

Engine Terminals—Improvement of these facilities represents a great outlay to provide for larger engines, more business and better arrangement to insure prompt movements. In particular, the great length of modern locomotives has required widening or reconstruction of enginehouses and the introduction of longer turntables. Changes in engine runs due to physical or wage conditions and changes in yard locations sometimes necessitate the construction of entirely new engine terminals.

Coaling and Water Stations—Improvement in these facilities is being carried out on a large scale. As in the case of engine terminals, many new installations are being made to supersede older ones, to serve alterations in engine runs or to provide additional facilities. In some cases large reservoirs have been established for water supply. Two special features are: (1) The greatly increased use of mechanical coaling and ash handling plants in order to reduce manual labor to a minimum, and (2) the wider adoption of chemical treatment of water, with recognition of the importance of such treatment in relation to efficient operation.

Belt Lines—At many large cities there are belt lines which connect the several radiating main lines and facilitate the transfer of through cars, while keeping this business out of congested local terminals. One of the few new examples of this is the belt line at Flint, Mich., completed in 1923, while projects for Detroit and for the New Jersey side of New York Harbor are under consideration. The Indianapolis belt line is facing the problem of track elevation.

Stations and Terminals—A large amount of work is being done in the reconstruction of stations of the smaller class, with an attempt in many cases to combine economy and permanence of construction. Of large stations, the most notable are the Chicago Union Station, to be completed in 1924; the St. Paul Union Station, now 50 per cent completed; the Cleveland Union Station, in its early stages, and the new double-deck freight stations of the Pennsylvania R.R. at Detroit and the Burlington R.R. at Chicago. Interest centers also in the Chicago controversy over four independent projects to build another large passenger station for the joint use of several roads now using three old stations and in the legal features of the Los Angeles joint terminal. It is unfortunate that the idea of unification or unit operation of terminals in large cities has been shelved. The principle involved, which became prominent during the war, is economically sound, but its application has many difficulties and there has been a great amount of misunderstanding as to what the plan really means and involves.

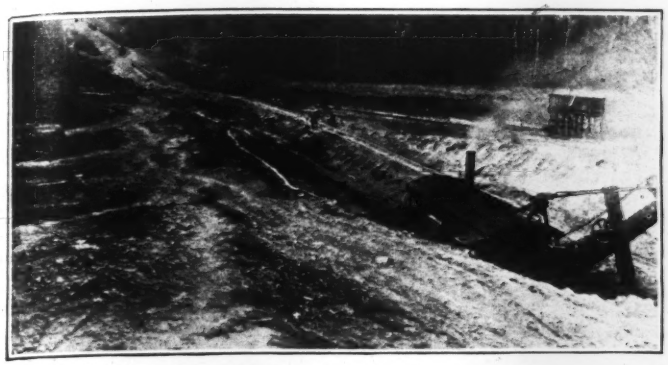
Grade Separation

The elimination of grade crossings of streets and highways is in a special class as a railway improvement, since it is undertaken mainly for the benefit of the community and the non-traveling public. The work does benefit the railroads in giving greater freedom of movement and greater safety, reducing delays, eliminating the cost of crossing protection and also reducing the liability of accidents and damage suits. It may also result in improving the profile. But as a rule these benefits are not commensurate with the high cost, especially where a heavy proportion of the cost is paid by the railroads.

By far the most notable work of this kind in large cities is at Chicago, where track elevation has been carried out by numerous railroads on many miles of line and at enormous cost. In recent years the activity has slackened, largely on account of the high cost and small financial benefit, but the city authorities are now pressing for a revival of the program. The demand in several of the smaller cities is made reasonable from the fact that the railroad passes through the business section of the city, interfering with traffic movements and property development and constituting an element of danger. The financial conditions of the railways will limit very strictly the amount of this costly work which can be undertaken, at any one time. For this reason it will be to the interest of the cities to assume a reasonable share of the cost in view of the importance of the work to the community.

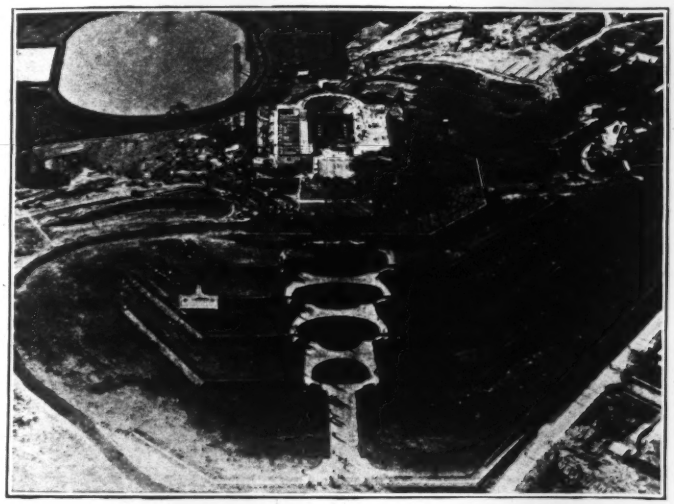
As to grade crossings on country highways, the number is so great that when multiplied by an average cost the total expense becomes prohibitive. It is true that every crossing is a potential danger point and that many accidents occur at crossings having very light traffic, but on the other hand it is logical to consider the busiest crossings first.

Photographic Review of 1923 Construction Progress



ILLINOIS CENTRAL'S NEW LINE IN KENTUCKY

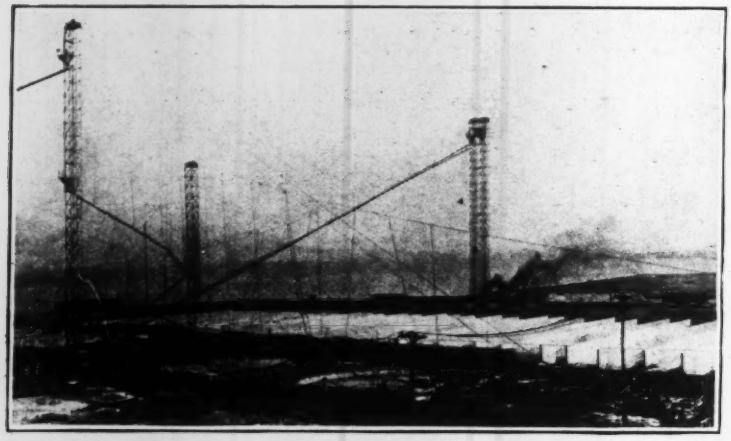
NEW HYDRAULIC PRESSURE TUNNEL
Bore is 32x32 ft. in section and 4,300 ft. long. Serves Niagara Falls Power Co. plant, Niagara Falls, N. Y.



AIRPLANE VIEW OF MASONIC MEMORIAL, ALEXANDRIA, VA.

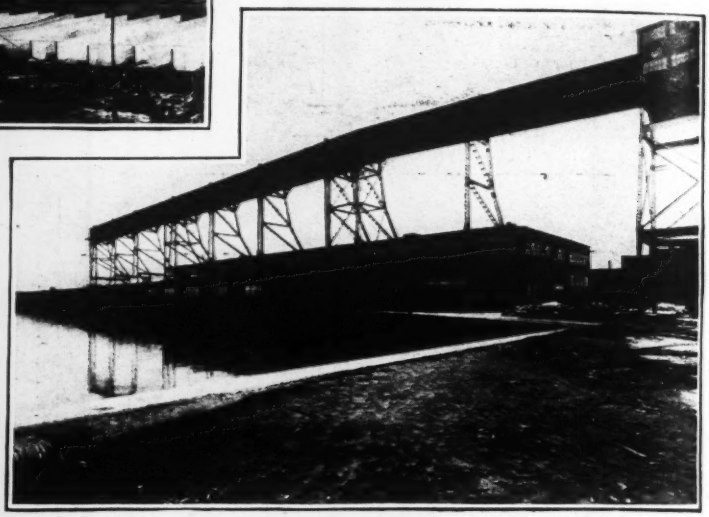
SHELTON HOTEL, NEW YORK CITY
Residential hotel for men; tallest structure of kind in New York; good example of building conforming to zoning regulations

PORTION OF RECENTLY COMPLETED SUNOL AQUEDUCT
Spring Valley Water Co. 70-m.g.d. line from Calaveras watershed to San Francisco. Aqueduct is 6 ft. square in section

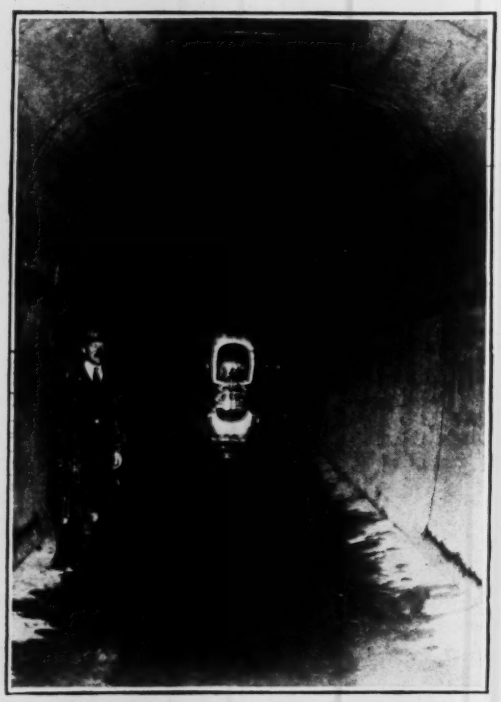


SEWAGE DISPOSAL PLANT, MILWAUKEE,
Twelve of the aeration tanks have walls practically complete. Sedimentation tanks under construction; pile foundations for other twelve aeration tanks to the left

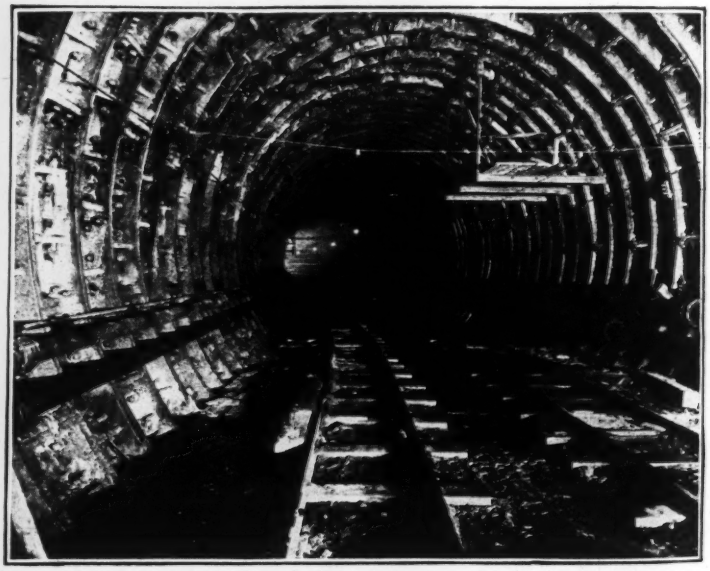
CASTING CONCRETE PIPE FOR TULSA OKLAHOMA, WATER SUPPLY LINE



STATE PIER AND GRAIN GALLERY, PORTLAND, MAINE
Berthing space 1,000 ft. long; water depth of 35 ft. at mean low tide.

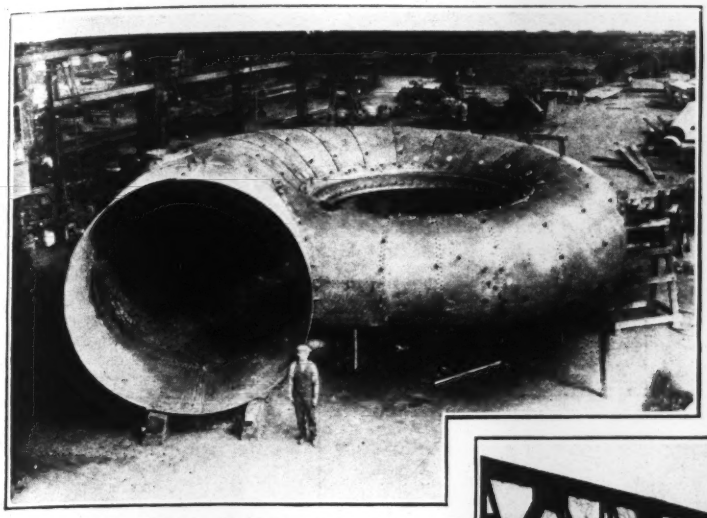


SHANDAKEN TUNNEL, N.Y.WATER SUPPLY
Longest tunnel in the world, being 18.1 miles in length. Interior dimensions are 11½ ft.x10 ft. 3 in. Built from seven intermediate shafts. Excavation, 700,000 cu.yd.



ABOVE: NEW YORK-NEW JERSEY VEHICULAR TUNNEL
View of 1,000-ft. radius curve in South Tunnel, N. Y., under West St. Photo taken Dec. 6. Camera at Ring 65.

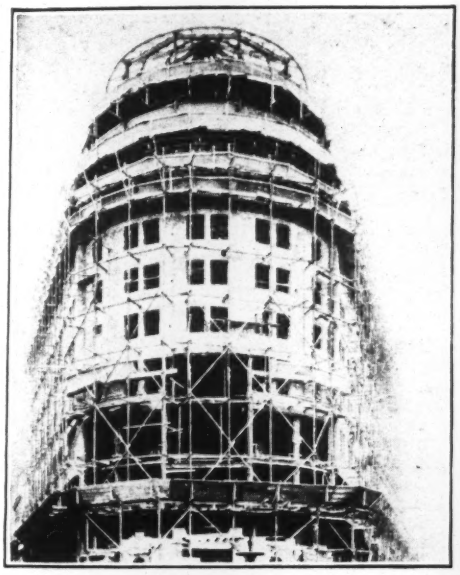
AT LEFT: ROAD WORK IN SAN JOAQUIN VALLEY
Preliminary to hydro-electric tunnel construction



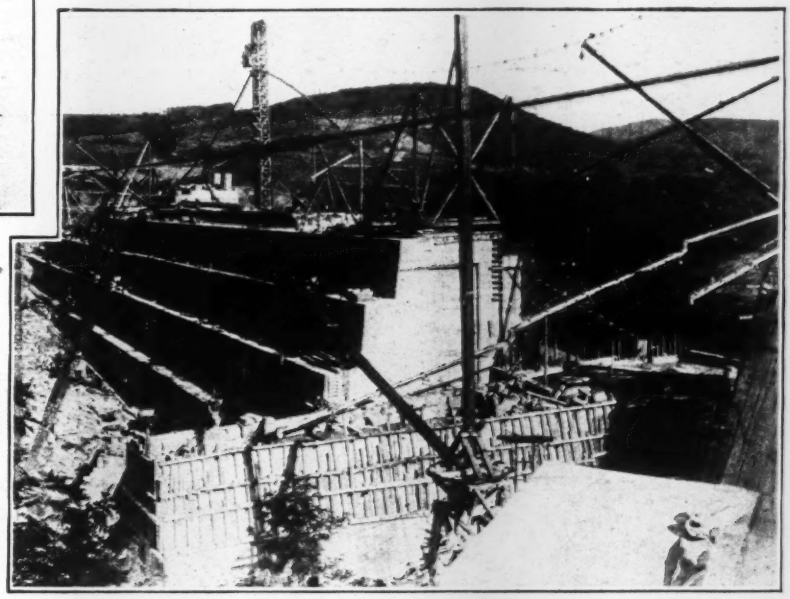
CASING FOR 11,000-HP. TURBINE
One of two plate steel spiral casings for the Clarion River Power Co. at its Piney Creek development in Pennsylvania

REPAVING FIFTH AVENUE NEW YORK CITY

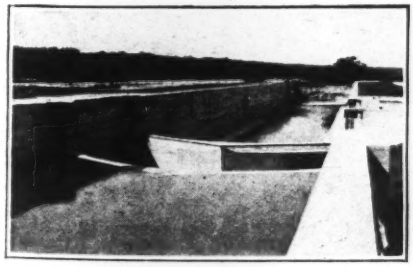
BRIDGE ACROSS WHITE RIVER AT HAZLETON, INDIANA
One of longest highway structures in Middle West has eight steel and 21 concrete spans of 2,002.5 ft. total length, and 5,000 ft. of approach embankment. Dedicated in early December



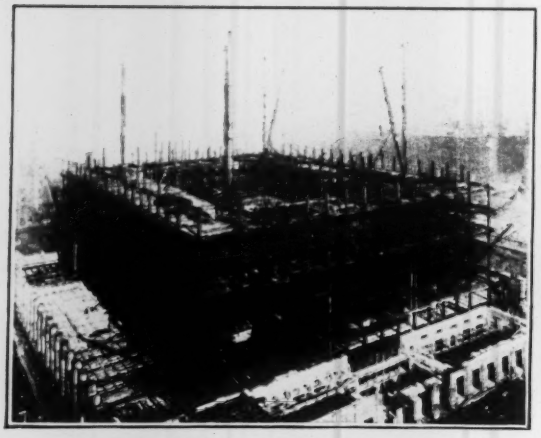
BANK IN BUENOS AIRES, ARGENTINA
First National Bank of Boston's branch recently completed in the South American city



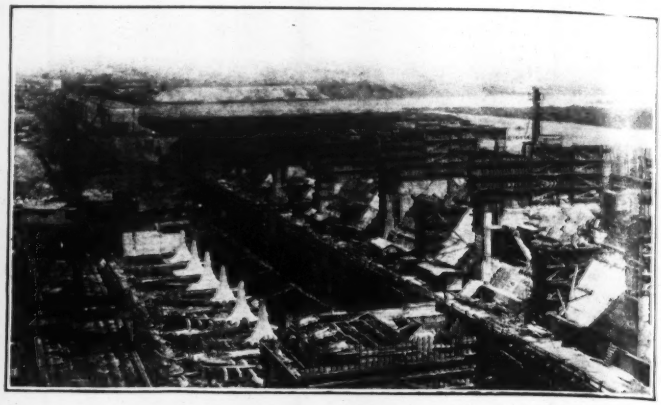
GILBOA DAM, NEW YORK CITY WATER SUPPLY
Structure is of gravity masonry type with a maximum height of 160 ft.



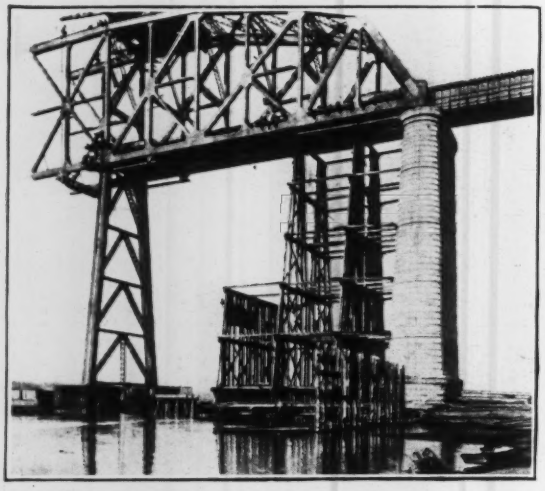
MARSEILLES LOCK: ILLINOIS WATERWAY PROJECT
Looking downstream from approach wall above lock



CHICAGO UNION STATION HEADHOUSE
Photograph taken Dec. 6. Jackson Street in foreground. Note wide terrace at lower level.



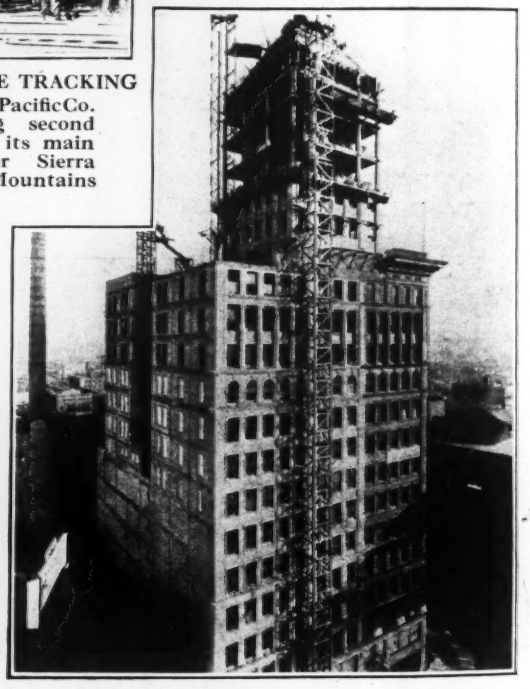
WILSON DAM ACROSS TENNESSEE RIVER AT MUSCLE SHOALS, ALABAMA



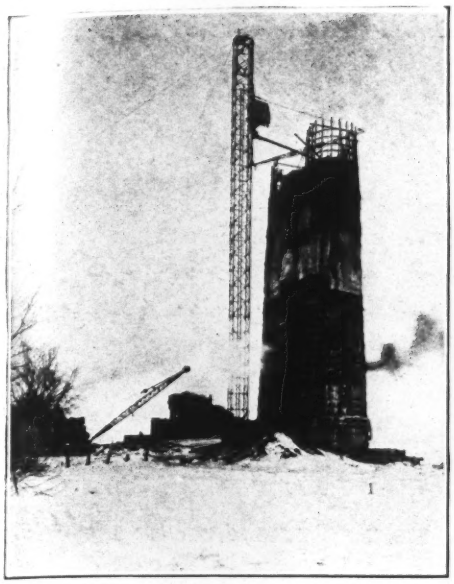
CASTLETON BRIDGE ACROSS HUDSON RIVER
Steel erection on east pier of N.Y.Central structure near Albany. Note timber falsework and central steel support

S. P. DOUBLE TRACKING
Southern Pacific Co. is laying second track on its main line over Sierra Nevada Mountains

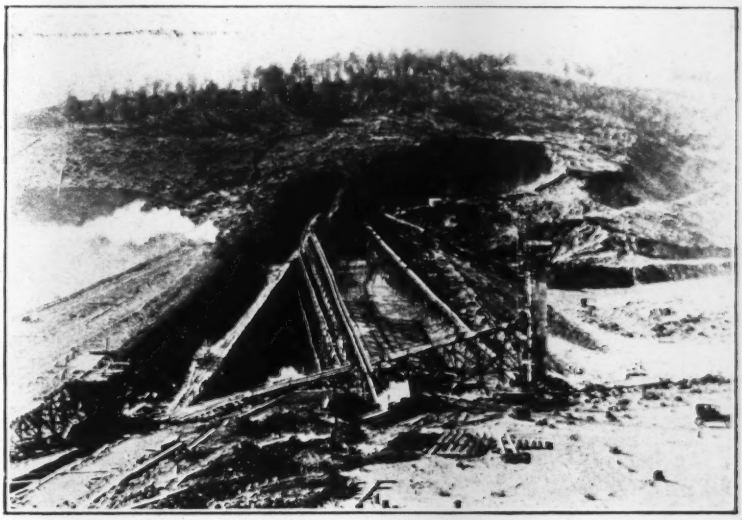
VICTOR TALKING MACHINE CO. BUILDING AT CAMDEN, N. J.



HIGHEST REINFORCED-CONCRETE BUILDING
United Brethren Building in Dayton, Ohio, has 21 stories and is 276 ft. high from sidewalk. First 14 stories 59x129 ft.; upper 7 stories 50x50 ft.



EAST RIVER PIER, CASTLETON BRIDGE
New York Central's bridge over the Hudson River below Albany

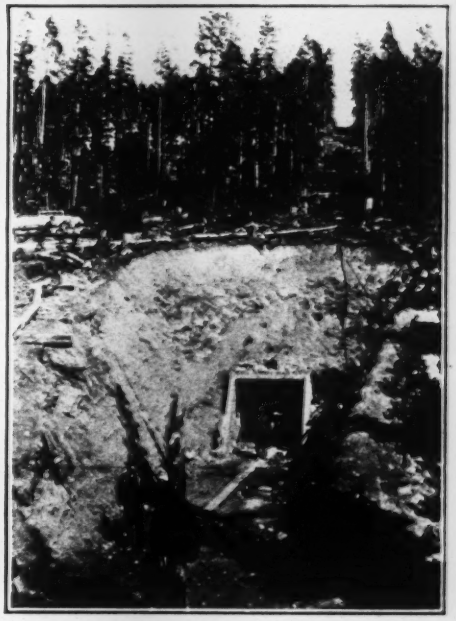


COMBINATION WET AND DRY FILL DAM, CALIF.
Upstream side of Priest Dam on Hetch Hetchy project was sluiced into place while fill downstream from corewall was hauled in on rails

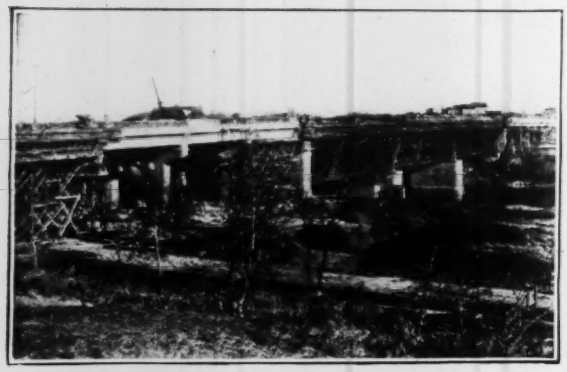
ABOVE—SUBWAY WORK IN CINCINNATI

RIGHT—4-STRIP CONCRETE PAVEMENT
A 42-ft. pavement on Commonwealth Ave., Boston, built in four longitudinal sections

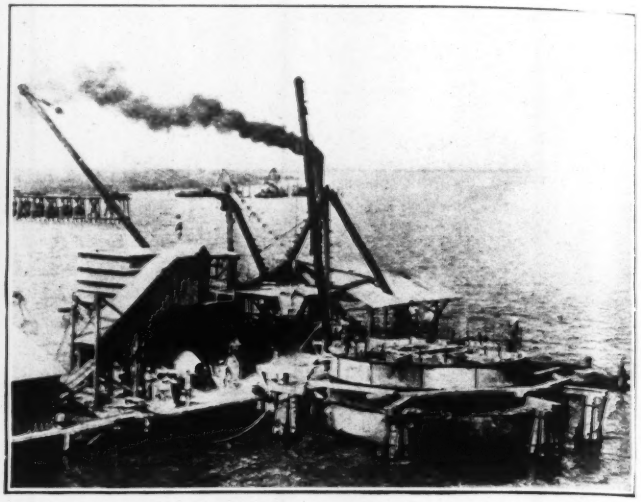
BELLE ISLE BRIDGE, DETROIT
Cantilever arch structure, 2,200 ft. long, was opened to traffic in November



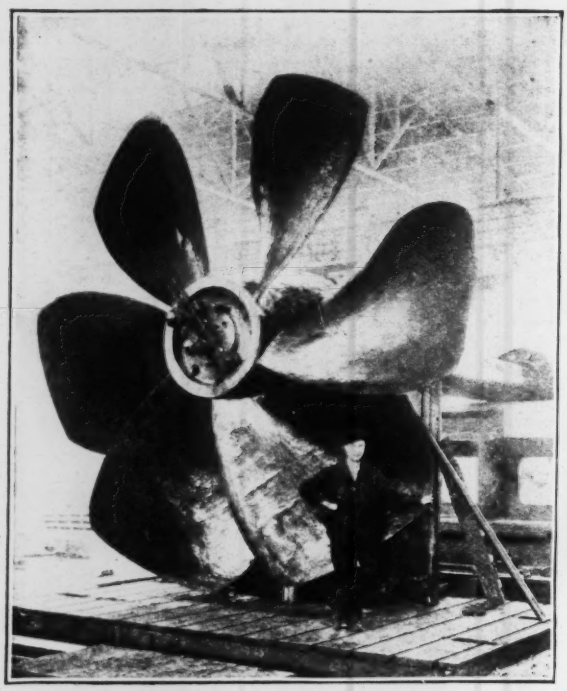
WEST PORTAL OF MOFFAT TUNNEL
Pilot tunnel of bore which will shorten by many miles crossing of Rockies in Colorado



QUEEN CITY BRIDGE AT MANCHESTER, N. H.
Highway structure of steel riveted deck spans and reinforced-concrete approach spans crosses Merrimack River in south portion of city



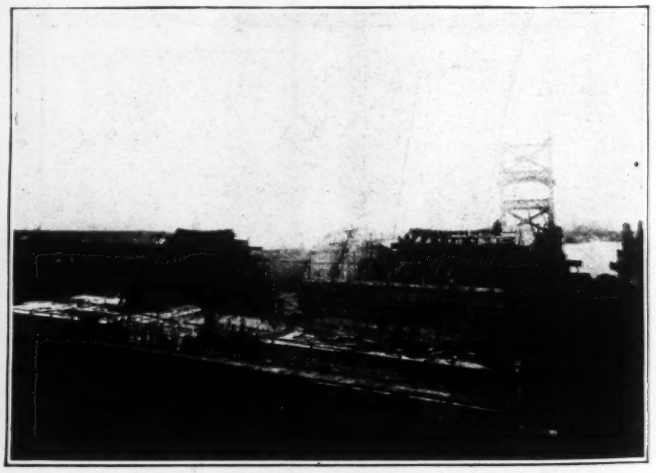
CONCRETING PIER ON RIGOLETS BRIDGE, LOUISIANA



PROPELLER-TYPE RUNNER OF 16-FT. DIAMETER
Runner for 28,000-hp. turbine for plant of Manitoba Power Co. at Winnipeg, Manitoba

O'SHAUGHNESSY STORAGE DAM FOR COLUMBUS, OHIO
Height, 65 ft. Has spillway 1,000 ft. long. Impounds 5,244,000,000 gal. of water. Surmounted by 12 concrete arches carrying 30-ft. roadway

CAMP LAYOUT ON WESTERN POWER PROJECT
Big Creek No. 3 project from near top of penstock line. Note network of inclined railways. Mess hall and warehouse near work; hospital and clubhouse overlook river



PHILADELPHIA-CAMDEN SUSPENSION BRIDGE
General view of Philadelphia anchorage and main tower. Two eye-bar nests in foreground. Seats for supporting steel anchorage bents in middle background

These four photographs illustrate article on "Aerial Photography an Aid to Better Map Making," by Gerard H. Matthes

FIG. 1—STREET INTERSECTION, HOLLYWOOD, CALIF.—SCALE OF VIEW: 100 FT. TO THE INCH
Photograph is a full size reproduction of print taken with camera of 20-in. focal length lens, and at an elevation of 2,000 ft. Photographs taken by Pioneer Aerial Engineering Co., Beverly Hills, Calif.

FIG. 2—SECTION OF LOWER COLORADO RIVER—SCALE OF VIEW: 1,000 FT. TO THE INCH
Survey covered 325 sq.mi. and 446 exposures were required. Assembly made exact by system of triangulation previously executed. Work done by Pioneer Aerial Engineering Co. View is a full size reproduction of print

FIG. 3—KERN RIVER VALLEY, CALIF.—SCALE OF VIEW: 400 FT. TO THE INCH
Part of a mosaic made for flood studies undertaken by Quinton, Code & Hill, consulting engineers, Los Angeles. Photograph by Pioneer Aerial Engineering Co. View is a full size reproduction of print

FIG. 4—BACKWOODS COUNTRY OF ALABAMA—SCALE OF VIEW: 800 FT. TO THE INCH
Typical of the work being done by the Alabama Power Co. in its water-power study of the Tallapoosa River. Exposures made from altitude of 9,600 ft. with lens of 12-in. focal length. View is a full size reproduction of print.

View of Clinch River Country, Tennessee. Scale, 1,250 ft. to the inch. Photo taken from an altitude of 15,000 ft.

Aerial Photography An Aid to Better Map Making

An Explanation of the Uses to Which the Engineer Can Put the Bird's-Eye, Mosaic and Line Maps in Revivifying and Bettering Map Making—An Art to Which the Past Thirty Years Have Added Little Progress

By Gerard H. Matthes
Consulting Engineer, Los Angeles, Calif.

THE ADVENT of aerial photography in the realm of the surveyor and map maker is to be hailed as most timely. There is a feeling in the engineering profession, especially among older men, that the maps being turned out by modern engineering organizations are not what they ought to be, and often are not the equal of those produced a quarter of a century ago. The hope has been expressed of late that aerial photography, if properly developed and applied, may become synonymous with better engineers' maps—maps that will be intelligible to the engineer's clients, be they farmers, promoters, lawyers, or bankers.

Undeniably, map-making has shown little progress of recent years, and is due for a forward step. In the last thirty years, text-books have been revised and enlarged, but no startling innovations or improved methods are disclosed in them. Instrumental equipment, aside from such appliances as the invar tape and the Beaman arc, has undergone no noteworthy changes. It is doubtful if all of the improvements in technique and equipment in the last thirty years have increased the efficiency of the average surveying party as much as has the automobile, use of which enables surveyors to spend more time on the job and less on the road.

It cannot be argued that no progress or improvement is needed. Those who have access to extensive map files and handle them continually can testify to the fact that the later maps show a falling off in the quality of both field and office work, though there are exceptions to this, and the writer knows of instances where the reverse is true. The fact remains that the average blueprint map of today is so lacking in detailed information that it is almost meaningless to the layman.

Causes of Lack of Progress—Two factors appear responsible for this state of affairs. The first is *standardization*, which has, without doubt, stifled originality and established beaten paths outside of which the average engineer dare not tread. The printer, illustrator, and advertiser, untrammeled by standards or rules, have within the last thirty years achieved truly remarkable progress, and alongside of their handiwork the conventionalized product of the map maker remains obscure and uninteresting to the average citizen.

The second factor that has operated to hinder progress in map making is the decline in the availability of highly-trained personnel. The professional surveyor of old, the man who took pride in his calling and made it his life work, is nearing extinction, at least outside the government service. It has become the custom with engineering firms, having surveys to make, to hire young men just out of college or those of scant experience. Hardly any of them show any desire to make surveying their vocation, because it is not sufficiently remunerative. There is no likelihood that this situation will improve.

In the drafting room, map making has ceased to be the fine art that it was years ago, to be acquired only through years of painstaking experience. It has become a job for young engineers whose careers require a certain amount of drafting room experience. There is now in the drafting room less real skill, less pride in achievement, more ingenuity to cut corners and save an hour of tedious work, than there was a quarter of a century ago. Aside from bottled India ink, vertical map files, and the photostat, there have been no really noteworthy improvements in drafting room methods and appliances. On the contrary, it is common to find that because of the difficulty of securing highly-skilled draftsmen, it

has become necessary to lower the standards of drafting technique, and we find this reflected even in the requirements of civil service examinations.

Importance of Aerial Photography—Aerial photography has offered many possibilities for improving upon the older methods of map making. The results that are being obtained in this comparatively new field lead to the belief that the experimental stage has been passed, and that aerial photographic mapping is destined to play an increasingly important part in the future activities of engineers and surveyors.

It may be said at the outset that the limitations inherent in vertical photographs which have caused doubt in the minds of the more conservative engineers as to their practical utilization in the construction of accurate maps, have not yet been overcome. But the errors resulting from these limitations are being eliminated through quite simple processes. It has become possible to construct aerial maps possessing any degree of precision that may be reasonably desired for engineering purposes.

Improvement in Technique—Probably the most important recent forward step has been the introduction of the hypersensitized pan-chromatic film, manufactured by the Eastman Kodak Co., which came into general use a year ago. Though definition obtainable through its use is a vast improvement over the earlier work, the chief advantage of the new film is its greater sensitiveness making possible the taking of clear and sharp exposures at all hours when good sunlight is available. Aerial work, therefore, is no longer limited to the few hours in the middle of the day as was the case two years ago. The necessity of keeping the hypersensitized film at a low temperature through the use of ice, to prevent its deterioration, is a disadvantage which it is trusted may be overcome in due time.

Progress has been made in other directions. All types of camera in use have undergone improvement, and the latest type out, the Bagley four-lens camera, gives promise of becoming the ideal mapping camera for covering large areas. The weakest link in aerial photographic equipment today is the altimeter, a barometric instrument used by the aviator for determining his altitude. In construction it bears analogy to the aneroid barometer, most of whose unreliable characteristics it appears to possess. Other things being equal, therefore, the chief difficulty with which the aerial map maker has now to contend is the lack of uniformity in scale of the photographs.

Various types of stereoscope have been evolved suitable for viewing aerial photographs and bringing out their topographic and cultural features into prominent, and often slightly exaggerated, relief. The value of the stereoscope for this purpose cannot be overemphasized. It has become an indispensable part of aerial photographic survey equipment. The engineer who examines aerial photographs through a stereoscope in his office is now enabled to get a better bird's-eye view than the aviator who took the pictures. More than that, the engineer in the office can view and study the terrain in minute detail and at his leisure. This introduction of a third dimension in visualizing the terrain is invaluable for any purposes, but especially for those of the engineer.

The technique of making exposures from the air calls for a high order of skill which in turn implies considerable training. The closest teamwork between pilot and photographer is required to secure first-class results. The pilot's duties, especially, require unusual alertness and dexterity. It is generally conceded that the manner in which he maneuvers the airship has a more important bearing on the quality of the final map than has the making of the exposures.

Research in aerial photographic mapping was started some years ago by the War Department at the experimental field at Dayton, Ohio. Important contributions to the art have come from that source, and further progress may be expected. Almost equally important contributions have been made within the last few years by commercial concerns engaged in aerial mapping. There is also some individual experimental work going on and it seems by no means improbable that new and better processes may be evolved.

Uses of Aerial Photographs—Three distinct uses are now being made of aerial photographs by engineers in this country: (1) The oblique or bird's-eye view; (2) the mosaic map, built up by assembling a number of overlapping vertical photographs into a continuous photographic map; and (3) the hand-drawn or line map, obtained by tracing off the more important features shown in vertical photographs. Each of these forms has its specific field of usefulness, and in each case that field has been expanding steadily.

The oblique view, because of the ease with which it is obtained, is destined to become popular with engineers for illustrating reports. Usually it is superior to a plan or map whenever ability to scale distances is not a requisite because it conveys more to the client than is possible to convey in words or through the presentation of old-style line maps. In this connection, the article by Fred H. Tibbetts in *Engineering News-Record*, Dec. 7, 1922, is worthy of review. It brings out clearly the value of oblique views in engineering reports and describes the simple procedure involved in obtaining them.

Of the two forms of map, the mosaic has had wider vogue. It is adaptable to many uses and has reached a high state of perfection. Its accuracy, through improved methods of rectifying and assembling, makes it a most serviceable map for engineering purposes. Among its more recent uses should be mentioned preliminary surveys for railroads and for power transmission lines. The latter is proving especially useful and is finding favor with hydro-electric companies.

The line map, usually made on tracing cloth, has found practical application in this country only within the last two years, although it is not a novel process. Its first extensive use was in the survey of the Tennessee River commenced by the War Department in 1921 and still in progress. The method consists in platting contours on contact prints using plane-table and stadia, and then tracing off, in final map form, the information so obtained together with any other features shown in the photographs that may be pertinent to the purposes for which the map is being prepared. The correct position of each photograph is secured by means of an ingenious system of control derived from the photographs themselves. Considerable interest is being manifested by engineers who have had opportunity to inspect this method, and it is likely to find wide application. The success had on the Tennessee River survey induced the Alabama Power Co. to adopt

the same method in making its survey of the Tallapoosa River recently. Both of these surveys are notable for the large extent of territory involved. In the Tennessee River basin to date over 1,000 sq.mi. have been photographed on a scale of 1,250 ft. to the inch, and the prospect is that eventually an area of 2,500 sq.mi. will be covered. The Tallapoosa River survey extends over more than 500 sq.mi. and was mapped on a scale of 800 ft. to the inch. In both surveys contour lines were sketched on the original photographs in the field. The principal advantages of the method are the elimination of cumbersome details, the dispensing with rectification processes, and the ability to make the map at once on tracing cloth, thus insuring convenience in handling, filing, and reproducing.

No claim is made here that aerial photography is a panacea for the ills that beset present-day map making. It is not a cheap process. The saving in cost that can be effected through its use over the older methods, though considerable, is not in itself a sufficient recommendation for its adoption. Rather, it is the saving in time, the excellence of the finished product, the vast amount of information made available, and the usefulness of the form in which this information is supplied, that combine to make aerial photographic maps, whether in the form of mosaics or line maps, superior to maps made by ordinary surveying methods.

Representative Photographs—The illustrations on pp. 23 and 24 are reproductions, to full scale, of portions of aerial photographs selected because of certain features in them of peculiar interest to engineers. Fig. 1 shows a street intersection in Hollywood, Calif., on a scale of 100 ft. to the inch, a scale that is extraordinarily large in aerial photographic mapping. To obtain it, it was necessary to use a lens having a focal length of 20 in. and to make exposures from an altitude of 2,000 ft. Objects within a radius of 2 in. from the center of the picture are, for all practical purposes, in true vertical projection. Near the edges of the photograph the projection becomes disturbed through the obliquity of the rays entering the camera, and as a result the sides of buildings become visible, indicating "displacement," as it is called, of the upper portions of tall objects. This displacement is common in photographs of cities but exists also, though not noticeably, in photographs of mountains or hilly regions. For this reason, it has become customary to eliminate the outer portions of aerial photographs in making mosaics.

An accurate mosaic map built up from photographs such as shown in Fig. 1 affords an ideal means of studying municipal engineering problems such as street widening, grade-crossing eliminations, and traffic congestion. Curb lines, street-car tracks, telephone and electric light poles, the exact outlines of buildings, trees, and vehicles, can be distinguished without difficulty in the original print. Where the photographic work is of a high degree of excellence, a scale half as large as that shown in Fig. 1, say 200 ft. to the inch, is quite as well adapted for municipal engineering studies and can be obtained at about one-fourth the cost of the larger scale. The mosaic of a portion of the city of Los Angeles, on a 200-ft. scale, described in *Engineering News-Record*, June 8, 1922, has proved reliable as regards scale and has been used with success by engineers engaged in planning the relief of traffic congestion in that city.

Fig. 2 shows a small section of one of the most remarkable aerial mapping undertakings of its kind—the survey of the lower Colorado River and its delta, which covers an area of 325 sq.mi. on a scale of 1,000 ft. to the inch. It required 446 exposures, and these were assembled in correct position by a system of triangulation previously executed. The aerial photographic work was done by the Pioneer Aerial Engineering Co. of Beverly Hills, Calif., who carried out their dangerous task in a masterly way. The completed mosaic affords an excellent illustration of the value of aerial photography in engineering studies. A close inspection of Fig. 2 will reveal a wealth of information that could not have been obtained by any other process. The delta lands, with their multitude of ever-shifting channels, islands, and bars, present a hopeless task for a detailed survey by ordinary instrumental methods. A line map of such a region could not be made to portray the true condition of things, and would at best be misleading. The dark areas in Fig. 2 are caused by dense growths of vegetation; the small white areas are deposits of alkali salts.

Fig. 3 is one of a large number of photographs used in the construction of a mosaic map of the valley of Kern River, California, on a scale of 400 ft. to the inch. It was made for Quinton, Code & Hill, consulting engineers of Los Angeles, for use in flood studies. The river bed is conspicuous by its sandy condition and absence of water, while an ample supply of water appears to be flowing in a capacious irrigation canal near by. A bituminous macadam highway and concrete highway bridge figure prominently in the picture. The large amount of detail made available by the 400-ft. scale is noteworthy and invites comparison with the 1,000-ft. scale of Fig. 2 and the 800-ft. scale of Fig. 4.

Fig. 4 shows a section of backwoods country in Alabama, and is typical of the aerial photographic work done by the Alabama Power Co. in the course of its survey of the Tallapoosa River in connection with water power studies. The exposures were made from an altitude of 9,600 ft. with a lens of 12-in. focal length, giving a scale of 800 ft. to the inch. The photograph shown in Fig. 4 was taken in late winter when the deciduous trees were bare and their shadows long. This accounts for the streaked appearance of the hardwood timber areas. Pine trees are conspicuous by their dark forms and dense shadows. The light colored areas are cotton fields, and the sinuous lines in them are so-called "terraces" or miniature levees for arresting the destructive erosive action of storm water. But for these terraces, which are laid out and maintained by the farmers with considerable care and the use of a variety of home-made leveling devices, there would be no tillable land worthy of the name in that section of Alabama. The dense growth of weeds on the terraces causes the latter to show up in marked contrast to the remainder of the fields which in winter are practically bare. It should not be imagined that these terraces, which resemble contour lines, follow the contours of the ground with any great fidelity. Being designed primarily to insure proper drainage they are laid out on light grades. They conform closely to true contour lines, however.

Fig. 4 is of interest also in showing how plainly the section lines and other land subdivision lines may be traced out by noting the position of fences. This feature has proved of considerable value in determining property lines in right-of-way work.

Chicago's Diversion of Water from the Great Lakes

A History of One of the Noted Cases of Water Diversion with State, National and International Complications Which Is Once More a Subject of Possible Litigation, Federal Legislation and International Agreement

THE CONTINUING controversy that for thirty years has centered on the diversion of the waters of Lake Michigan by the metropolitan district of Chicago is fast coming to a head. In the past this diversion, the construction and operation of which has cost $120,000,000 and is the key to the whole sanitary control of this thickly populated area, has been the subject of state law, court orders, suits in equity, federal departmental rulings, and international agreements. In spite of all of this its exact status has not been established. The growing importance of lake navigation and of water power is forcing some definite legal statement of this status; the question involves a fundamental principle in connection with both national and international water diversion. The subject is very involved. There are many ramifications in its history and in the contentions of those arguing on either side of the controversy. These many complications cannot be fully entered into, but the engineering reader can be informed of the fundamentals of the subject, which is sure to be of growing importance in the next year or two.

Chicago River Reversed—The city of Chicago and several of its suburbs, acting through an extra municipal body known as the Sanitary District of Chicago, have deepened the channels of the rivers normally emptying into Lake Michigan at Chicago and cut through channels so that the waters of Lake Michigan are diverted across the low height of land into the Mississippi valley, the flow thus diverted being used to dilute the sewage of the city of Chicago and to deliver it into the Mississippi, rather than into Lake Michigan, from which the drinking water of the district is taken. The project was started nearly forty years ago on the recommendation of competent sanitary engineers under authority of the State of Illinois. It has never been the subject of express legislation by the federal congress, though it has had repeated attention by the United States War Department which, under the authority conferred by the interstate commerce clause of the Constitution and its later implications as to navigable waters, has from time to time issued orders regarding the diversion.

Opposition to the diversion has been offered on three sides: (1) By the Mississippi valley which has objected to the dumping of Chicago wastes, and by the Illinois and Desplaines River valleys, who fear flood danger; (2) by both the American and Canadian navigation interests of the Great Lakes, who have claimed that the lowering of the level of the lakes by diversion has hindered navigation, and (3) by both Canadian and American power interests at the lower end of the lakes, particularly at Niagara, and on the St. Lawrence, who have contended that this diversion is depriving the outflow rivers of the Great Lakes of flow which could be converted into power. The sanitary objections in so far as the State of Missouri is concerned were overruled by a decision of the United States Supreme Court many years ago. The flood dangers have been at least alleviated by levees. The navigation complaint is at present mainly embodied in a federal suit now before the courts against the Chicago Drainage District and actively promoted by several of the Lake states north of Illinois. The power question takes main form in the imminent international discussion between the United States and Canada preliminary to the formulation of a new treaty for the utilization of the waters of the Niagara and the St. Lawrence rivers.

History of the Project—The Chicago drainage canal and its successors are the result of the long continued efforts of the city of Chicago to divert its sewage from its water supply in Lake Michigan. The lake here is separated from the Mississippi basin by a low divide which in the earliest days was always a portage and occasionally a headwater swamp providing at least rowboat passage. In 1836-48 the Illinois and Mississippi canal was built across this divide by the State of Illinois with the approval of the federal government, and from then on to the formation of the Chicago Sanitary District some water was diverted from the lakes, primarily for navigation but incidentally to some degree for sanitation.

The Sanitary District of Chicago was organized under an act of the General Assembly of the State of Illinois dated May 29, 1889. It now comprises an area of 437 sq.mi., including all of Chicago—about 200 sq.mi.—and some forty-nine other incorporated cities and villages. It served in 1923 a population of 3,213,000. The district has police powers and the power of eminent domain, and is supported by taxes. Bonds may be issued for permanent improvements up to 3 per cent of the assessed valuation. While the district was formed primarily to dispose of sewage by dilution and outlet into the Illinois River, it has also power to provide such other means of sewage disposal "as might be necessary when the capacity for dilution is exceeded."

Following the recommendations of a board of engineers, consisting of Rudolph Hering, Benezette Williams, and Samuel A. Artingstall made in 1887, the main feature of the project consists in the diversion of lake water through the rivers to provide a minimum dilution of 200 cu.ft. per minute, or 3.33 cu.ft. per second, for every thousand people resident in the district. This project comprises a main drainage canal, with capacity of 10,000 sec.-ft., extending 28 miles from the Chicago River at its lake mouth to the controlling works at Lockport, Ill., partly in the excavated beds of the Chicago and Desplaines rivers and partly in new channel; the north shore channel, a distributing channel in the north branch of the Chicago River; the Calumet-Sag channel, with a 2,000 sec.-ft. capacity, extending from a junction of the Little Calumet River just east of Blue Island to a connection with the main channel of Sag, reversing the flow of the Calumet River and diverting sewage in the southern part of the district; some extra channel improvements on the three branches of the Chicago River, and the many pumping stations and intercepting sewers required to complete

the diversion. By a subsequent charter, the district utilizes the water power generated in the flow. This is used for pumping sewage, operating sewage treatment plants, lighting city streets, parks and boulevards. The theoretical power available with the flow of 10,000 sec.-ft., for which the main channel is designed, is 36,000 hp. under a head of approximately 34 ft.

In addition to all this, the district since 1909 has built a number of sewage treatment plants and has others under consideration. As so far announced, however, these plants are intended only to treat the sewage surplus which can not be cared for by the dilution method through the canals, with a total flow of 10,000 sec.-ft.

Legislation and Permits—As stated above, the Sanitary District of Chicago was authorized by an act of the Illinois Legislature, passed May 29, 1889. The first request for a federal permit made by the district was addressed to the Secretary of War, June 16, 1896, at which time the excavation of the main drainage canal was well under way. This request was to widen and deepen the south branch of the Chicago River at designated points in order that it might have a capacity to conduct to the head of the artificial canal a flow of 5,000 sec.-ft. at a velocity of 1½ miles per hour. The request was granted by letter of the Secretary of War, July 3, 1896, under specified conditions, among which was the following: "That the authority shall not be interpreted as approval of the plans of the Sanitary District of Chicago to introduce a current into the Chicago River. This latter proposition must be hereafter submitted for consideration." Further permits with respect to the river were granted in succeeding years up to 1899. On April 22, 1899, the district made application to the Secretary of War for permission to open the canal as soon as completed and discharge through it waters of the Chicago River and Lake Michigan, reversing the current in the Chicago River. This permit was granted May 8, 1899, it being expressly stipulated that the permit was temporary and revocable at will; that it would be changed if found necessary to protect commerce in the river from unreasonable obstruction because of the current, or to protect property from injury, and also that "it is distinctly understood that it is the intention of the Secretary of War to submit questions connected with the work of the Sanitary District of Chicago to Congress for consideration and final action and that this permit shall be subject to such action as may be taken by Congress."

An additional permit was granted July 11, 1900. On April 9, 1901, the permit of May 8, 1899, was modified restricting the flow through the Chicago River and its south branch to a maximum of 200,000 cu.ft. per minute, equal to 3,333⅓ sec.-ft. In the next two years this permit was varied several times, but finally permission was granted to divert no more than 4,167 sec.-ft. after March 3₁, 1903. This permit is still in force.

There is some difference of statement as to how much flow is actually being diverted. The sanitary district reported in 1917 drafts increasing up to 7,786 sec.-ft.; the U. S. Engineer Department has questioned these amounts and suggested that they should be from 5 to 12 per cent greater. It is certain, however, that the average total draft from the lake is far above 4,167 sec.-ft., probably being near 10,000 sec.-ft.

One proponent of the district has recently stated that the capacity of the main canal is limited to a total of 10,400 sec.-ft. to keep within the operable head at the power plants. However at times of heavy rains in the Chicago River drainage area, that river tends to return to its normal flow into the lake. On the latest occasion of this sort, last August, over 13,000 sec.-ft. was diverted from the lake to prevent the river with its sewage content from emptying into the lake. One of the main contentions of Chicago for the permission for the higher flow is that such a flow is insurance against the return of the sewage to the lake.

When the Calumet-Sag canal diversion was contemplated, the district made application to the Secretary of War for further permission. This was first denied, but on June 30, 1910, a permit was granted to complete the canal and appurtenant works provided that the amount of water withdrawn from Lake Michigan through the Chicago and the Calumet rivers together shall not exceed the total (4,167 cu.ft. per second) already authorized to be withdrawn through the Chicago River alone. Further permits for other diversions continue to restrict the total amount to this 4,167 sec.-ft., although the district filed with the secretary applications for an enlargement of the permit of 1899, as modified by subsequent permits, to a flow not to exceed 10,000 sec.-ft. These later petitions were all denied. Since then, bills have been introduced into Congress authorizing a diversion of 12,000 sec.-ft., but so far without success.

Lawsuits—The first suit against the district was the famous St. Louis-Chicago suit brought by the State of Missouri the day the canal was opened. The suit was a proceeding in equity calling for an injunction against the district for draining into the Mississippi River the sewage and drainage of the district. The suit ran through several years and included many volumes of evidence, but finally, on Feb. 19, 1906, the Supreme Court of the United States dismissed the case "without prejudice."

On March 23, 1908, the Attorney General of the United States caused to be filed in the United States Circuit Court a bill of complaint seeking to enjoin the Sanitary District of Chicago from constructing the Calumet-Sag canal. It was alleged by the government, in brief, that this would decrease the navigability of Lake Michigan. The case went through several years and in 1913 the Attorney General caused another bill in equity to be filed praying that the district be enjoined from diverting more than 4,167 sec.-ft. from Lake Michigan to the Chicago River. The two suits were consolidated and heard as one, and on June 19, 1920, the district judge, Kenesaw M. Landis, rendered an opinion decreeing that the Sanitary District be enjoined from diverting more water than was authorized by the War Department. The injunction has not been issued.

The issues in the federal suit are interesting and can be expressed no better than in the words of the report by W. S. Richmond, of the United States Engineer Department, embodied in the well-known Warren report on diversion of water from the Great Lakes.

It was averred that Congress had never authorized any diversion through Chicago River, and that the diversion recommended by the Chief of Engineers and permitted by the Secretary of War was limited to 4,167 sec.-ft.; that the diversion greatly exceeded this amount and was therefore unlawful under section 10 of the rivers and harbors act of March 3, 1899. It was further held that the defendant

by this unauthorized diversion modified and altered the Chicago River, and also lowered all the Great Lakes except Superior, and all the overflow rivers, injuring them and obstructing navigation.

The Sanitary District answered denying that it asked for lake water or other than Chicago River water, that its diversion exceeded 4,167 sec.-ft., that it had or would lower lake levels, that it injured navigation, or that permission from the Secretary of War was necessary. It claimed that its works were required under the police power of the state of Illinois by the Sanitary District Act of May 29, 1889; that the works planned would completely care for the necessary sewage and drainage; that they provided the only method of keeping sewage out of the lake and preserving the drinking water pure; and that this exercise of police power was paramount to any federal authority. It claimed further that a diversion of 10,000 sec.-ft. was necessary to keep flood waters out of Lake Michigan; that the diversion was absolutely necessary to the health of the people; that because of the very low watershed and the very large population Chicago's case was very unlike that of any other lake city; that $82,000,000 had been spent on the work while the United States knew of the state's action and yet did not protest; that the United States had co-operated to the extent of spending $1,000,000 on the improvement of the Chicago River; that it had indicated its approval by many investigations and in reports of its officials; that in the case of the United States vs. Economy Light & Power Co. it had held that the state, by diversions from Chicago River and Lake Michigan, had made the navigability of the Desplaines River an accomplished fact; that government records show that the full lowering claimed by the government could be compensated at an expense of $5,000,000 or less; that the lake levels had been lowered by the act of the United States, of Canada, and of private persons; that the United States had no right to limit the diversion; and that it would cost about $300,000,000 for some other method of caring for the sewage and water supply, which was prohibitive because of the constitutional debt limit, and which could not provide a method as satisfactory or efficient, and that $82,000,000 already expended would be practically wasted.

It has been frequently announced in the last few months that various of the lake states, prominent among which are Wisconsin and Minnesota, are now organizing to join with the federal government in an action before the Supreme Court to restrain the Sanitary District from "excessive diversion from the lakes."

International Treaties—Prior to the beginning of this century there was no international supervision of the use of the waters of the Great Lakes. In each country such works were built and such water diverted as was desired, and no protest was made by the opposite nation when the Canadian canals or the American water power diversion in New York State were built. The construction of the Chicago drainage canal and the large power developments at the Soo and at Niagara Falls followed by some unusually low water in the early '90's alarmed the shipping interests to such an extent that an agitation was started which finally led to the appointment of the International Waterways Commission of 1902, resulting ultimately in the International Joint Commission. A report of the International Waterways Commission, dated May 3, 1906, laid down some general principles applicable to all diversions or uses of water adjacent to the international boundary. These principles maintain that in all navigable waters the use for navigation purposes is the primary and paramount right, that permanent or complete diversions of navigable waters or their tributary streams should be permitted for domestic purposes only and for the use of locks and navigation canals. Where the water is taken and returned and the diversions do not interfere with navigation, each country is to have the right to diversion in equal quantities.

Following this report a treaty was finally negotiated in 1910. The important feature of this treaty is that it permits in the upper Niagara River the diversion of 36,000 sec.-ft. in Canada and 20,000 sec.-ft. in the United States. There has been much discussion as to the reasons for this inequality and the matter is of some importance in its relation to the Chicago diversion. Two contentions are made: First, that the inequality was due to a recognition of the existing conditions, the amount being fixed at 36,000 sec.-ft. in Canada to allow the companies on that side the amounts of water for which they then had works under construction. The commission said, in its preliminary discussions, that the Canadian advantage is more apparent than real since the power generated on the Canadian side to a large extent would be transmitted to and used in the United States. At the same time, it is recognized from the text of the discussions before the commission that the Chicago diversion, together with the power diversions of the Welland Canal and other smaller diversions, was considered in the establishment of the unequal allowances for the two countries. The joint report of the International Waterways Commission of 1906 (prior to the treaty) says: "The commission recommends that the diversions, exclusive of water required for domestic use or the service of locks, in navigation canals, be limited on the Canadian side to 36,000 sec.-ft., on the United States side to 18,500 sec.-ft. (and in addition thereto a diversion for sanitary purposes not to exceed 10,000 sec.-ft. be authorized for the Chicago drainage canal)." In 1907 the International Waterways Commission made certain recommendations on the Chicago drainage canal which concluded with the following words: "We therefore recommend that the government of the United States prohibit the diversion of more than 10,000 sec.-ft. for the Chicago drainage canal." The treaty does not mention the Chicago drainage canal, but limits the Canadian side to the recommended 36,000 sec.-ft. and raises the American side to 20,000 sec.-ft. This treaty, it should be noted, was between Great Britain and the United States, though the representatives on the International Waterways Commission were representatives of the Canadian government.

Repeated overtures have been made in the past two years by the United States State Department to Canada looking toward the negotiation of a new treaty, which would primarily readjust the permissible water usage at Niagara, but which would also establish some basis of international co-operation in the navigation and power improvement of the St. Lawrence. Canada has so far postponed definite answer. The situation there is complicated by political consideration, mainly the divergent views as to power development and navigation held by the dominant parties in the provinces of Ontario and Quebec. There is every indication, however, that the issue will be forced soon and some international action taken.

Power Development—At the time of the initiation of the Chicago drainage project there was no power of consequence being developed on the outflow rivers of the Great Lakes, but soon thereafter there began the great development at Niagara which has progressed to the point where now the diversion of so much as 10,000

sec.-ft. becomes of importance. By treaty arrangement as noted above, the use of the Canadian side of the river is now limited to 36,000 sec.-ft. and on the American side to 20,000 sec.-ft. There have been built, however, in the last two years on each side of the river two hydro-electric plants of high efficiency which produce much greater horsepower per second-foot of flow than those which had been built at the time the treaty was written. The Queenston-Chippawa plant of the Hydro-Electric Power Commission of Ontario with its ten 55,000-hp. units operating under a 304-ft. head will require 16,000 sec.-ft. or more flow. The three new 70,000-hp. units of the Niagara Falls Power Co. on the American side will generate 23 hp. per second-foot flow under a 223-ft. head and will therefore take about 9,400 sec.-ft. If either of these new plants are operated simultaneously with the less efficient plants which are already in operation, it is obvious that the treaty flow will be far surpassed. Advocates of the Chicago drainage district have claimed recently that this overdraft is actually taking place, but the contention of the Niagara Falls power interests is that the treaty provisions relate to a 24-hr. flow and not to an instant flow, so that they are not diverting more than that at the present time nor do they intend to operate all their new plants at the same time and thereby draw more water than they are entitled to.

Obviously, however, the coming development of Niagara depends on the international permission to use more water. The suggestion of Colonel Warren in his report noted below is that a provision be made for 40,000 sec.-ft. on either side, making a total of 80,000 instead of a total of 36,000 as at present. It is this increased demand for water which has brought forward at the present time the question of the legality or illegality of the draft which Chicago is making.

Partly incident to the whole question, too, is the matter of the desecration of Niagara Falls, a natural attraction whose preservation would be demanded by an overwhelming majority of the people. Further draft around the Falls for power might conceivably ruin their beauty. Colonel Warren in his report recommends the building of a weir above the Falls, the purpose of which would be to spread the waters more uniformly over the brink of both American and Canadian Falls and give a much more spectacular scenic effect with lower flow.

Lake Levels—It will be recognized that the effect of such a diversion as this on the levels of such a large body of water as the Great Lakes is one which cannot be easily settled. There have been many investigations and studies made into the subject. The drainage district, however, has recognized the lowering effect to some extent. It admits, not necessarily for legal purposes but in effect, that the 10,000 sec.-ft. diversion will lower the level substantially 5½ in. in Lakes Michigan, Huron, St. Clair, Erie, and Ontario, and their appurtenant rivers, and that this will constitute an obstruction to navigation in that it does not permit the big freighters to carry within 400 or 500 tons of what they normally would without the diversion. While the district does not admit this categorically, it does to the extent that it has offered to participate in the construction of a regulating works in the Niagara River, which will maintain the lakes at the same level they would have without the Chicago diversion, and offers also to co-operate with the federal government in the designing of other types of regulating works with a view to navigational betterment in the backwater rivers.

River Navigation—A navigation channel from the Lakes into the Mississippi has been agitated since the earliest settlement of the West. It took tangible form in the Illinois & Michigan Canal in 1848 and it was the main point of consideration in the War Department's restriction of current in the 1887 Drainage Canal. Its present manifestation is the Lakes-to-Gulf waterway, which is embodied in a bill before Congress authorizing a 10,000 sec.-ft. diversion through the present canals in order to lessen the maintenance and dredging charges in the proposed 9-ft. Illinois River Channel, which is the upper end of the Mississippi navigation system. On the other hand the diversion is opposed by those who favor the proposed St. Lawrence waterway, which would open the Great Lakes to the Atlantic for ocean-going ships via canals around the Soo and Niagara and a canalization of the St. Lawrence River.

The Warren Report—In 1921 a report was made by Col. J. G. Warren, Corps of Engineers, U. S. A., on the subject of diversion of water from the Great Lakes and Niagara River. This report was endorsed by the board of engineers for rivers and harbors, the Chief of Engineers, and the Secretary of War. Colonel Warren's own recommendations were that the Sanitary District be permitted to divert a total flow of 10,000 sec.-ft., but that it pay its share of the cost for compensating works considered necessary to maintain the proper level of the Great Lakes and that it pay the United States for the water it uses for power purposes. The report was reviewed by the board of engineers for rivers and harbors, which dissented from Colonel Warren on two points. It recommended a limit of diversion of 6,800 sec.-ft. instead of 10,000, and that the provision for exacting payment for power was inexpedient. The board maintained that Chicago was debarred from any claim for indulgence as to work done and expenditures incurred, because it had been expending money on the diversion in defiance of government opposition.

Conclusions—The case reduces itself to the contentions of Chicago that it is necessary for the health of its citizens to divert at least 10,000 sec.-ft. of the waters of the Great Lakes to be used for the dilution of sewage and that health rights are paramount; (2) that the diversion is based on the authority of the State of Illinois which at the time it was given was the only authority required for such diversion; (3) that there can be no international complications in the diversion because the treaty of 1910 was signed in full recognition of the fact that Chicago was entitled to the 10,000 sec.-ft. diversion; (4) that the use of water power on the canal is merely secondary to its use as a sewage diluent and that it is being used only as an aid in the further disposal of that sewage; (5) that it is inconceivable that the power rights of the lower lakes and rivers should be made superior to the health necessities of so large a body of people as that residing in the Sanitary District; (6) that such lowering of the lake levels as may be produced by the drainage canals shall be amply compensated for by the remedial construction which the drainage district offers to build; (7) that the drainage district is proceeding with all possible speed to purify such sewage as cannot be taken care of by dilution through the drainage canals, but that such progress must be slow because of the high cost.

Principal Hydro-Electric Developments Completed or Under Construction in 1923

Company	Plant	Number of Units	Horsepower: Unit Capacity	Horsepower: Total, New Installation	Head	Year of Operation
UNITED STATES						
Alabama Power Co.	Lock 12 (Coosa River)	4	17,500	109,000	70	1923
		2	19,500			
Alabama Power Co.	Mitchell Dam	3	24,000	72,000	70	
Alabama Power Co.	Lower Tallassee			24,000	.....	1923
Alabama Power Co.	Cherokee Bluffs	2	44,000	88,000	.....	1925
Alabama Power Co.	Upper Tallassee	3	3,100	9,300	60	1925
Arkansas Light & Power Co.	Ouachita	..	.....	15,000	.....	1924
Adirondack Power & Light Co., (N. Y.)	East Canada Creek	..	.....	*18,000	.....	1924
Adirondack Power & Light Co., (N. Y.)	Sprite Creek	..	.....	6,000	400	1924
Bar Harbor & Union River Power Co. (Me.)	Ellsworth	..	.....	3,300	62	1923
Blue Ridge Power Co., (N. C.)	Turner Shoals	..	.....	10,000	.....	1923
California-Oregon Power Co.	Link River	1	4,400	4,400	50	1924
Central Maine Power Co.	Oakland	..	.....	4,500	.....	1924
Clarion River Power Co. (Pa.)	Piney Creek	2	11,000	22,000	80	1923
Dixie Power Co.	White River	..	.....	50,000	.....	1924
Empire District Electric Co. (Kan.)	Table Rock	..	.....	60,000	.....	1926
Eugene Municipal (Ore.)	McKenzie River	1	3,000	3,000	.....	1925
Farmington River Hydro-Electric Corp. (Conn.)	New Boston	..	.....	7,600	.....	1924
Feather River Power Co. (Calif.)	Bean Creek	..	.....	62,000	.....	1925
Ford Motor Co. (Mich.)	Iron Mountain	..	.....	10,000	.....	1925
Ford Motor Co. (Minn.)	St. Paul	..	.....	20,000	.....	1924
Georgia Ry. & Power Co.	Mathis	..	.....	*15,000	.....	1924
Georgia Ry. & Power Co.	Tugalo	4	22,000	88,000	149	1924
Georgia Ry. & Power Co.	Bullshine	..	.....	*5,000	.....	1924
Georgia Ry. & Power Co.	Leeds	..	.....	6,000	.....	1925
Georgia Ry. & Power Co.	Burton	..	.....	6,000	.....	1925
Georgia Ry. & Power Co.	Tugalo & Tallulah	..	.....	*30,000	.....	1926
Great Western Power Co. (Calif.)	Caribou	1	30,000	*30,000	1,008	1926
Great Northern Paper Co. (Me.)	Anson	5	1,500	7,500	20	1924
Idaho Power Co.	Snake River	2	9,000	*18,000	58	1923
Indiana Hydro-Electric Co.	Norway	..	.....	2,500	.....	1924
International Paper Co. (N. Y.)	Sherman Island	4	10,000	40,000	64	1923
Kentucky Hydro-Electric Co.	Dix River	..	.....	25,000	235	1923
Lake Superior District Power Co.	Flambeau	..	.....	16,000	.....	1924
Lockwood Mills (Me.)	Waterville	..	.....	6,000	.....	1925
Los Angeles Municipal (Calif.)	San Francisquito	1	16,000	*16,000	940	1923
Louisville Electric Co. (Ohio)	Falls of Ohio	..	.....	75,000	.....	1923
Minnesota Light & Power Co.	Jim Falls	3	4,800	14,400	50	1926
Minnesota Utilities	Kawishiwi	1	6,000			1923
		2	3,000	12,000	.....	
Montana Power Co.	Mystic Falls	2	7,500	15,000	1,150	1923
Moreau Mfg. Co. (N. Y.)	Feeder Dam	5	1,500	7,500	15	1924
New England Power Co. (Vt.)	Davis Bridge	2	19,500	39,000	345	1924
New England Power Co.	Vernon			4,200	35	* 1924
Niagara Falls Power Co.	Niagara	3	70,000	210,000	213	1923-24
New York State	Crescent Dam	4	4,000	16,000	26	1924
New York State	Vischers Ferry	4	4,000	16,000	26	1924
Northern New York Utilities, Inc.	Flat Rock	2	1,600	3,200	62	1924
Northern New York Utilities, Inc.	Effley Falls	1	2,100	2,100	57	1924
Northern States Power Co.	High Bridge			80,000	.....	1924
Northern States Power Co.	St. Croix Falls			*9,000	.....	1925
Pacific Gas & Electric (Calif.)	Pit River No. 3	3	33,000	99,000	313	1925
Pacific Power & Light	Hood		.....	8,700	.....	1923
Pacific Power & Light	Deschutes		.....	40,000	.....	1926
Pennsylvania Power & Light	Hawley		.....	50,000	.....	1925
Pennsylvania Water & Power Co.	Holtwood	2	20,000	40,000	54	1924
Penobscot Power Co. (Me.)	Medway	6	1,000	6,000	16	1923
Phoenix Utilities Co. (Idaho)	Spray Plant	2	9,000	18,000	55	1924
Phoenix Utilities Co. (Minn.)	Fond-du-Lac	2	15,000	30,000	.....	1924
Portland Ry. & Light Co.	Oak Grove	1	35,000	35,000	960	1924
Power Corp. of New York	Herrings Plant	3	6,750	20,200	21	1924
Roanoke Rapids Power Co. (N. C.)		1	3,200	3,200	30	1924
Salt River Valley Water Users Ass'n. (Ariz.)	Roosevelt Dam	1	10,000	10,000	160-230	1923
San Francisco Municipal	Moccasin Creek	4	25,000	100,000	1,315	1924
San Gorgonio Power Co. (Calif.)	Plant No. 1	1	2,300	2,300	1,785	1923
San Joaquin Light & Power Corp. (Calif.)	Balch No. 1	1	.....	31,000	2,495	1926
Seattle Municipal	Gorge Creek	2	22,700	45,400	275-375	1924
Southern California Edison Co.	Big Creek No. 3	3	35,000	105,000	740	1923
Southern California Edison Co.	Big Creek No. 1	1	22,500	*22,500	2,150	1923
Southern Power Co. (Great Falls, S. C.)	Dearborn	3	17,000	51,000	68	1923
Southern Power Co.	Catawba			50,000	.....	1924
Southern Power Co. (Mount Holly, N. C.)	Mountain Island	4	22,700	90,800	80	1923
Southern Sierras Power Co. (Calif.)	Forest Home Plant	1	3,000	3,000	2,050	1924
Southern Sierras Power Co. (Calif.)	Levening No. 1	1	14,000	*14,000	1,654	1924
Southern Sierras Power Co. (Calif.)	Levening No. 3	1	3,300	3,300	384	1923
Southern Sierras Power Co. (Calif.)	Owens River	1	13,400	13,400	280	1925
St. Croix Paper Co.	Grand Falls	1	4,500	4,500		1923
Tennessee Electric Power Co.	Great Falls	1	22,200	22,200	142	1924
Turlock & Modesto Irrig. Dist. (Calif.)	Don Pedro	3	12,000	36,000	100-240	1923
United Hudson Electric Corp. (N. Y.)	Sturgeon Pool	3	6,000	18,000	105	1924
United States Government (Tenn.)	Muscle Shoals	4	30,000	120,000	92	1924
Utah Power & Light	Soda Springs	2	10,000	20,000	76	1924
Washington Water & Power Co.	Long Lake	1	22,500	22,500	168	1923
Washington Water & Power Co.	Orville	1	2,500	2,500	80	1922
Western States Gas & Elec. (Calif.)	Eldorado	2	14,000	28,000	1,750	1924
Watertown Municipal (N. Y.)	Delano Falls	3	2,700	8,100	26	1924
Wisconsin Valley Electric		3	2,500	7,500	25	1924
Yuba Development Co. (Calif.)	Bullards Bar	1	10,000	10,000	475	1924
CANADA						
British Columbia Electric Co.	Stave Lake	1	25,000	*25,000	110	1924
British Columbia Electric Co.	Alouette Lake	1	12,000	12,000	140	1925
Canadian Assoc. Gold Fields, Ltd. (Ont.)	Wendigo Falls		.....	6,000	.....	1924
Hollinger Cons. Gold Mines, Ltd. (Ont.)	Island Portage	2	12,000	24,000	60	1924
Hydro-Electric Power Comm. of Ontario	Queenston-Chippawa	1	52,000		.....	
Hydro-Electric Power Comm. of Ontario	Queenston-Chippawa	3	58,000	*174,000	305	1923-1924
Hydro-Electric Power Comm. of Ontario	Trent River	3	2,200	6,600	32	1923
Hydro-Electric Power Comm. of Ontario	Cameron Falls	2	12,500	*25,000	72	1923
Manitoba Power Co.	Great Falls	1	28,000	*28,000	56	1925
Newfoundland Power & Pulp Co.	Humber River	7	14,000	98,000	.....	1925
Northern Canada Power Co. (Que.)	Des Quinze River Falls	2	10,000	20,000	70	1924
Nova Scotia Power Comm.	Malay Falls	3	1,900	5,700	43	1924
Ottawa & Hull Power & Mfg. Co. (Que.)	Calumet Island		.....	25,000	60	1924
Price Bros. & Co. Ltd. (Que.)	Chicoutimi	1	11,000	11,000	72	1924
Quebec Development Co.	Lake St. John	8	40,000	320,000	300	1924
Shawinigan Water & Power Co. (Que.)	La Gabelle	4	33,000	132,000	65	1924
Shawinigan Water & Power Co. (Que.)	Shawinigan Falls	1	43,000	*43,000	.....	1923
Southern Canada Power Co. (Que.)	Hemming Falls	6	5,600	33,600	50	1924
Winnipeg Municipal (Man.)	Point du Bois	3	8,500	25,500	.....	1924

* Additional Installation in Existing Plants.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

State and Municipal Bond Issues Declined in 1923

The total amount of state and municipal bonds issued in 1923, according to *The Daily Bond Buyer*, New York City, was $1,075,000,000, or 15 per cent less than in 1921. The figures for the last seven years, to the nearest million dollars, are: 1917, 445; 1918 (year of Capital Issues Committee restrictions) 263; 1919, 770; 1920, 774; 1921, 1,383; 1922, 1,280; 1923 (approximate), 1,075. The average size of the loans increased from about $90,000 in 1917 and earlier to $150,000 (due in part to the deflated dollar). A population increase estimated at 13,000,000, besides the sale of $275,000,000 of State soldiers bonus bonds, are cited by the *Bond Buyer* as factors to be taken into account in connection with the foregoing figures.

Diven Again Superintendent of Troy Water-Works

John H. Diven, secretary American Water Works Association, resumed his former position of superintendent of water-works at Troy, N. Y., on Jan. 1. He resigned his position at Troy in August, 1919, to devote his entire time to the secretaryship just named, with headquarters in New York City. Mr. Diven was in active water-works management for nearly fifty years at Elmira, N. Y., Charleston, S. C., and at Troy, beginning in November, 1873. He will continue to serve as secretary of the American Water Works Association, a position which he has held continuously since 1902, besides being secretary from 1889 to 1892 and president in 1892-93.

Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

E. J. Mehren became editor of *Engineering News-Record* at the time of the consolidation in 1917, and was succeeded by Frank C. Wight, Jan. 1, 1924.

The staff of *Engineering News-Record* consists of

New York: Frank C. Wight, *Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, J. W. Shaver and Van Tuyl Boughton.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

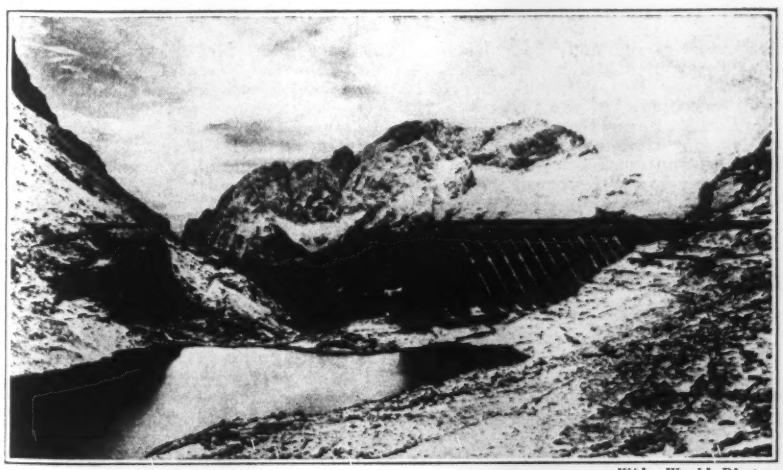
Governor Smith Would Create State Power Authority

Governor Smith, in his annual message to the New York State Legislature delivered yesterday, recommends that the city of New York be given more voice in the decisions of the Port of New York Authority by permitting the Board of Estimate to appoint two of the state's three members. He also recommends that by an amendment to the interstate pact the present New York and New Jersey Bridge and Tunnel Commission be transferred to the Port Authority, that the Port Authority issue bonds to complete the vehicular tunnel, to reimburse the two states for expenditures already made and to build connections between the tunnel and the highways. The governor would also have the Port Authority finance and build the Staten Island—New Jersey bridge.

In order to put an end to the present deadlock over the development of the hydro-electric power resources controlled by the state Governor Smith would have the legislature create a New York Power Authority with powers similar to those of the New York Port Authority, to develop the state's power resources through the issue of tax-exempt securities which would not be obligations upon the state. The power authority would construct super-power lines and sell power to municipalities at cost.

The governor would enlarge the home rule powers of the cities by abolishing the transit commission and giving the cities the power over existing public utilities within their corporate limits and authority to purchase, own and operate public utilities, including buses.

Views in Northern Italy Where Dam Failed Dec. 1, 1923



Wide World Photos

ABOVE: DAM AFTER FAILURE. RIGHT: WRECKED POWER HOUSE AND PENSTOCK

At Dezzo, near Bergamo, Italy, on Dec. 1, the dam impounding the waters of Lake Gleno broke, following heavy rains. Dezzo, below the dam, was practically wiped out, the loss of life being about 600. Failure of the structure released approximately 10,000,000 cu.ft. of water.

Frank C. Wight Becomes Editor of "News-Record"

Succeeds E. J. Mehren Who, as Vice-President, Will Direct Publication of Four McGraw-Hill Papers

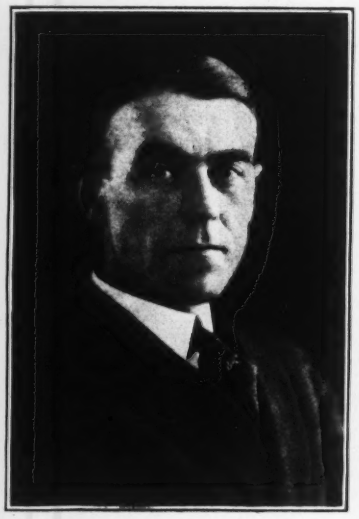
WITH this issue, *Engineering News-Record* appears for the first time under the direction of its new editor, Frank C. Wight. Effective Jan. 1 he succeeds E. J. Mehren, who withdraws after an editorial service of 16 years, of which 11 were in responsible charge as editor of *Engineering Record* and *Engineering News-Record*. As vice-president of the McGraw-Hill Co., Inc., Mr. Mehren will devote his time henceforth to the executive management of the Engineering Unit of the company's publications, comprising *Engineering News-Record, Engineering & Mining Journal-Press, Coal Age*, and *Chemical & Metallurgical Engineering*. A publisher's announcement of the change in administration appears on p. 1 of this issue.

Mr. Wight enters upon his new duties with a background of 17 years' editorial experience, in which he has devoted special attention to the general subjects of concrete design and construction, and river and harbor work. Born in Washington, D. C., Feb. 26, 1882, he studied at Columbian (now George Washington) University, and later at Cornell, where he was graduated with the degree of Civil Engineer in 1904. During his summer vacations while in college he was employed in the Surveyor's Office of the District of Columbia, and after graduation he spent three years in the office of the engineer of bridges of the District on the design and construction of the Connecticut Ave., the Piney Branch, and the Anacostia bridges.

Joins Staff in 1907

The new editor of *Engineering News-Record* has come up through the ranks to his present position. His entry into the field of technical journalism dates from December, 1906, when he joined the staff of *Engineering News* as associate editor. For six years his main assignments were the fields of concrete, general construction, and river and harbor work, necessitating a good many thousand miles of travel throughout the United States and Canada to points of engineering interest. This period offered an opportunity for the development of his journalistic bent and in 1913 his ability received recognition in a promotion to the managing editorship of *Engineering News*. This position he occupied until *Engineering News* and *Engineering Record* were consolidated in 1917, and four years later he became managing editor of the combined journal.

"Engineering News-Record's' New Editor, Whose Promotion Became Effective Jan. 1, 1924



Frank C. Wight

Among his outstanding journalistic achievements are an investigation and report on the failure of the Stoney River Dam in West Virginia, involving great physical hardships in a long hike through snow drifts, waist-high, to reach the scene of the disaster from the nearest railway station; numerous articles, based on personal examination, of the flood problems of the Mississippi River; studies of the effect of sea water on concrete; and writings on the subject of reinforced-concrete design and construction.

Mr. Wight is a member of the American Society of Civil Engineers, the Cornell Society of Engineers, and of the American Concrete Institute. In the latter organization he is a chairman of the committee on "Award of the Wason Medal" and a member of the committees on "Reinforced-Concrete Building Design and Specifications" and "Form of Standards"; for some years he has had editorial charge of the "Proceedings" of the Institute. He contributed several of the major articles on civil engineering to the "New International Encyclopedia" and for eleven years he prepared the review of civil engineering for the "American Year Book."

New Muscle Shoals Bill Amends Ford Offer

A bill introduced in the House of Representatives by Representative Dickinson of Iowa authorizes the lease of the nitrate and hydro-electric power plant at Muscle Shoals, on the Tennessee River, to Henry Ford on a new basis, which, it is understood, is acceptable to the present administration. The main feature of the new bill is that it is frankly a fertilizer subsidy. The nitrate plant is to be given to Mr. Ford without charge on the provision only that he manufacture there 40,000 tons of fixed nitrogen per year and sell it at a profit of only 8 per cent of the actual cost of production during that year to the company. The main other distinctions between the Dickinson bill and the original Ford offer are: first, that the lease is to be for only fifty years in accordance with the Federal Water Power Act instead of the hundred years asked by Mr. Ford; and, second, ttat Mr. Ford is to be required to pay 6 per cent of the total cost of the full Muscle Shoals hydro-electric property (leaving out the cost of works incident to navigation) instead of 4 per cent of the cost of such work, as are to be completed by the government subsequent to the acceptance of the offer as was specified in the original Ford offer. Such proportion of power as is to be required in the manufacture of nitrate will be paid for at a basis of 3 per cent, thus carrying further the subsidy idea.

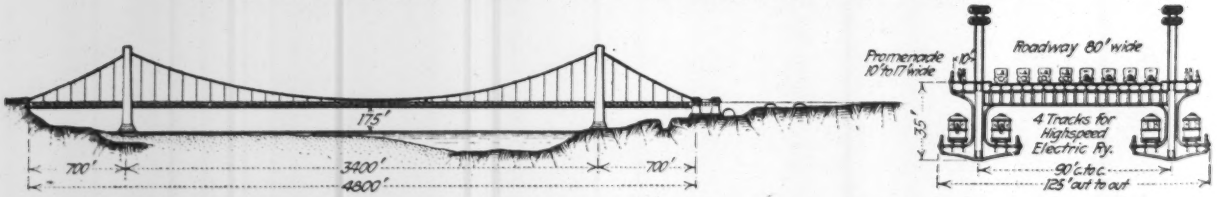
The idea of this bill is apparently to put the Ford offer on the same basis as other federal water power projects and to insure at the same time the production of nitrate. Provisions of the bill require that such power as is not used in nitrate production shall be sold under the rate control of the State Utility Commission and that the entire control of the plant as to the amount required in fertilizer production, etc., shall lie with the Federal Power Commission.

Passaic Valley Sewer Outfall Damaged by Leviathan

Divers of the Merritt, Chapman & Scott Wrecking Co., working for the Passaic Valley Sewerage Commission on Dec. 29, found that one of the two main branches of the Passaic Valley outlet conduit laid in a dredged channel beneath New York Harbor had been broken by the "Leviathan" when she went aground on Dec. 21. Investigation of the accident will be made by the United States Shipping Board.

The Passaic Valley trunk sewer will divert the sewage of Paterson, Passaic, Newark and other communities from the Passaic River into New York Bay.

Proposed Hudson River Bridge at Fort Washington Point, New York City



THIS plan is before the Port of New York Authority for consideration. It was worked out by O. H. Ammann and laid before Governor Silzer of New Jersey, who referred it with his recommendation to the Port Authority. The cost of the bridge is estimated at $30,000,000. Just east of its location the Harlem River is crossed by Washington Bridge, giving direct access to Bronx Borough and to highways leading to New England and eastern New York without entering New York's intensive traffic areas.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES. Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-21, 1924.

The San Francisco Section, Am. Soc. C. E., held its annual meeting on Dec. 18. Illustrated talks on the design and construction of the stadium at the University of California were presented by Thomas F. Chace, engineer in charge of structural design, and D. W. Ormsbee, resident engineer. Officers elected for 1924 were: President, Frank C. White, chief engineer, State Board of Harbor Commissioners, and vice-president, B. A. Etcheverry, professor of irrigation engineering, University of California.

The New England Water Works Association will hold its next meeting at the Boston City Club, Jan. 8. Robert E. Horton, consulting engineer, and E. Sherman Chase, sanitary engineer, will be the principal speakers.

Personal Notes

J. E. JELLICK has been appointed by the Portland Cement Association as district engineer in charge of its Los Angeles office. Mr. Jellick has for the past two years been field engineer in Los Angeles County for the association. He received his civil engineering training at the University of Idaho and for ten years previous to 1921 was engaged in engineering work for the Southern California Edison Co., and as senior resident engineer for the Los Angeles County road department.

PROF. FRANK P. MCKIBBEN, head of the civil engineering department of Union College, has been placed in charge of the engineering bureau of the city of Schenectady, N. Y. His term of service is for two years and he assumed office Jan. 1. President Richmond has allowed Prof. McKibben to arrange his work so that he will retain his direction of engineering instruction at Union. Prof. McKibben has had wide experience in the design and construction supervision of bridges and steel and concrete buildings, as well as experience in general engineering. He is a graduate of the Massachusetts Institute of Technology, where he served as instructor and professor for thirteen years, leaving that institution in 1907 to do similar work at Lehigh University. He was in charge of civil engineering at the latter institution until 1919, when he went to Union.

HARRY A. BRINKERHOFF, consulting engineer of Rutherford, N. J., who was not an applicant for the position, has been selected city manager of Portland, Me. His salary has been fixed at $10,000, press reports announce.

G. DOUGLAS ANDREWS, of New Cumberland, has resigned as district engineer of the Pennsylvania State Department of Health, his resignation becoming effective Dec. 31. Mr. Andrews first entered state service in 1909 as rodman in the engineering division of the department, and has advanced in positions of responsibility until he was appointed district engineer in 1920, having charge of an area along the Delaware River. During 1916 for several months he was assistant to the superintendent of construction at the McClintic-Marshall plant in Pottstown, going then to the Harrisburg Pipe & Bending Works. Mr. Andrews will assume charge of the Bureau of Sewers and Water of Easton, Pa., a position but recently created.

DR. J. A. L. WADDELL has been made a chevalier of the Crown of Italy by King Victor Emanuel. This is the fifth such foreign decoration which Dr. Waddell has received, the others in order of bestowal being, the order of the Rising Sun from Japan in 1888 in recognition of his services as instructor in the Royal University; the Order of Bien Faisance from Russia in 1906 for service in connection with the Russian railways; the Order of the Sacred Grains from the Chinese Government, the highest honor which China pays to a foreigner, for his services in connection with railroad development; the Order of the Sacred Treasure from Japan for services in educating young Japanese engineers.

R. A. BLACK, heretofore division engineer at Truro, N. S., for the Canadian National R.R., has been appointed division engineer of the new Halifax Division J. T. HALLISEY, superintendent at Truro, has been appointed superintendent, Halifax and Bridgewater Divisions.

Obituary

WILLIAM H. LEWIS, the well-known hydraulic-sluicing contractor of Seattle, died at his home in that city on Dec. 19. Mr. Lewis was the inventor of the sheerboard method of placing material in fills. He made a notable success of the very extensive regrading work done in the northern part of Seattle some fifteen years ago, directed the Westover Terrace regrading project in Portland, completed unfinished work on the Ochoco dam near Prineville, and at the time of his death was in charge of the Jackson St., Seattle, regrade work.

THOMAS W. RANSOM, formerly assistant city engineer of San Francisco, died in that city on Dec. 19 after an illness of several months. For several years prior to 1915 Mr. Ransom was in charge of mechanical engineering work for San Francisco. He supervised the installation of the high pressure fire protection system and was connected with the municipal railway extension. During the war he was engaged in ship repair work for the government and in recent years conducted a consulting practice in San Francisco.

ALEXANDER GUSTAVE EIFFEL, noted designer of the tower in Paris which bears his name, died in that city Dec. 27, aged 91 years. Mr. Eiffel had been retired from public life for the past thirty years. Although known in America in connection mostly with his design of the tower, he was known throughout Europe for more than a half century as one of its most eminent engineers. The Garabit and Douro steel arch railway bridges on the continent were among his pioneer undertakings and for a long while were the most notable structures of their kind.

WILLIAM H. V. REIMER, former city engineer of East Orange, N. J., and for almost half a century identified with its public improvements, died in that city recently, aged 75 years. His death resulted from shock received in an automobile accident Dec. 2. Mr. Reimer started upon his professional career in 1867, for many years maintaining an office in East Orange. He served the municipality first as town engineer, then as city engineer, retiring in 1909.

GEORGE GRAY ANDERSON, consulting engineer with wide experience in irrigation work, died Dec. 23, 1923, at his home in Santa Monica, Calif., from after-effects of influenza. Mr. Anderson was born in Aberdeen, Scotland, in 1858, graduated from the University of Aberdeen in 1874, and after some years' surveying and railroad work in Scotland came to America. In 1880 he was appointed assistant engineer on the construction of the High Line canal near Denver, Colo., and in 1883 was made chief engineer of that work and of three other Colorado canal systems. In 1890 Mr. Anderson took up private practice as consulting engineer, specializing in irrigation. Among the works with which he has been connected are the impounding of Lake Loveland, one of the first storage reservoirs for irrigation in Colorado; the Imperial Valley project, upon which he reported in 1896; and an irrigation project for the Alberta Railroad and Irrigation Co., in Canada. He built the water-works at Greeley, Colo., in 1906. In 1913, in association with Leonard Metcalf, consulting engineer, Boston, he made an appraisal of the property of the Denver Union Water Co., and in 1915 a report of the rights of the Spring Valley Water Co. of San Francisco. He served on the board of consulting engineers for the Imperial Irrigation District with C. E. Grunsky in 1917, and later as advisor to the Canadian government on a controversy over boundary waters between Montana and Alberta; and in 1919 acted as consulting engineer for Alberta on the Lethbridge Northern Irrigation District. At the time of his death Mr. Anderson was a director of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Many Changes Made During 1923 in Details of Construction Machinery and Materials

DEVELOPMENTS in the machinery and materials of engineering and construction during 1923 demonstrate one thing clearly: Manufacturers today are not content with a product which does its work only reasonably well. Returns from *Engineering News-Record's* canvass of about 500 makers of equipment and supplies indicate a continuing process of evolution in the manufactured products for engineers and contractors. This condition has been brought about by a desire to make a good machine better through changes in design which will increase the usefulness and economy of the equipment. For the most part these changes concern themselves with details of established practice rather than with new principles, for the chief types of contractor's plant have been fairly well standardized in their essential features.

The objects usually sought by altering details of design or construction are increased output, greater strength, more compactness, added durability, or greater mobility. These improvements sometimes mean higher costs, but the contractor of today is willing to pay more for plant that will ultimately return to him a higher yield on his initial investment. This fact is brought out in several of the replies received in the course of this journal's survey of the year:

A manufacturer of hoists says: "Among contractors the present trend is to purchase a higher grade of equipment than formerly. The original cost does not seem to enter into the purchase so much as the strength and life of the machine. That is as it should be." In another field—rock crushers—a manufacturer, commenting on an improvement made in his product, says: "It involved an increase in our prices and there was some doubt as to whether the average buyer would be willing to pay this premium. As a result of our sales for 1923, however, we know that the average buyer is more than willing to pay for improvements which increase the life and service of equipment."

The Major Trends

BEFORE presenting a summary of the detailed changes made in machinery and materials last year, comment will be made on what appear to be the indicated major trends or actual developments:

Standardization

Of primary importance is a well-defined movement toward standardization of both equipment and materials. Manufacturers have begun to realize the tremendous waste involved in supplying needless types or varieties of products. Through joint conferences among associations of manufacturers and contractors, supplemented, in some cases, by co-operation with the Division of Simplified Practice of the Department of Commerce, substantial progress along lines of simplification was made during 1923.

Paving Brick—Paving brick varieties, which had previously been cut from 66 to 7 were lowered one more notch during the year by the elimination of the repressed hillside brick, bringing the total of standard sizes to 6.

Asphalt—Reduction of varieties of asphalt for street and road work, as a result of a campaign initiated by *Engineering News-Record*, became an accomplished fact during 1923. Producers and consumers, in conference with the Department of Commerce, agreed to recognize as standard only 10 varieties (as determined by the penetration test). These include asphalt for all paving purposes, including brick and block filler.

Face Brick and Tile—Face brick sizes also were lowered from 39 to 1; and hollow building tile varieties from 36 to 12.

Concrete Mixers—In the field of construction machinery the outstanding case of simplification was in the concrete mixer field. Working in conjunction with the Associated General Contractors, the mixer manufacturers have agreed upon standard sizes for paving and building mixers as follows: Paving mixers, 21-E, 13-E, and 7-E; building mixers, 28-S, 21-S, 14-S, 7-S, 5-S, 3½-S. To designate machines which meet these standards a special name plate is to be employed by manufacturers. In addition, standard schedules were approved for kits of tools and accessories to accompany concrete mixers.

Wheelbarrows—Progress also was made in the standardization of wheelbarrows, particularly as regards capacities, gages of metal, handles and legs.

Lumber—A similar trend took place in lumber; a meeting last month participated in by the Department of Commerce and the Lumber Manufacturers Association accomplished much in the way of adopting standard sizes.

Tractor Power

The second marked development last year was the increasing use of the Fordson tractor as a mobile power plant. Ample evidence is at hand to prove that the usefulness of this machine has extended far beyond the limits of farming. It has made no uncertain entry into the industrial field. Tractors of the wheel or crawler types, of course, have been widely used on road-grading and hauling work, but the significant phase of last year's developments has been the incorporation, by manufacturers, of the Fordson tractor as the power plant for construction equipment. There have already been placed upon the market the following machines operated by Fordson power: Elevating loaders, lightweight road rollers, industrial locomotives, road graders, hoisting engines, saw rigs, trench excavators, concrete mixers, power shovels and snow plows. This has been a development of fairly recent origin and present signs indi-

cate an expanding use of tractor-engine power for operating construction equipment.

Tractors—both the wheel and crawler types—show an increased use on construction work, particularly road-building and large earth-handling operations. Manufacturers of equipment hauled by tractors—such as road graders, plows, wheeled scrapers, road drags, scarifiers, dump wagons, trailers—have felt the direct effect of this practice. It has been necessary for them to strengthen their equipment to stand up under the heavier pull and greater strains of tractor haulage as compared with team haulage.

Mobility Increased

During 1922 a great impetus was given to the mobility of construction equipment. Last year saw an even wider extension of this principle in the mounting of machines of all sorts on rubber-tired wheels or motor truck chassis. The larger, heavier equipment is usually carried on a four-wheel truck of some sort, while for the lighter machines, such as small building mixers, asphalt heating kettles for road work, trailer mountings were widely used. Some manufacturers have gone a step further than rubber-tired wheels, both solid and pneumatic, by the introduction of spring suspension to minimize the bumping and jarring of equipment during transport from one job to another.

Increased mobility also has been given to very heavy types of machines such as steam shovels, locomotive cranes and large paving mixers, by the development of low-platform trailers with rubber-tired wheels. Every effort is being made to minimize lost time during the transfer of a machine from one site to another.

Snow Plows

The demand for all-year-round use of highways has been responsible for the development, last year, of a wide variety of snow plows for attachment either to tractors or motor trucks. These have taken three general forms: First, the straight blade whose angle with the line of travel may be varied by suitable adjustments; second, the V-shaped plow generally attached to the front end of a tractor; and, third, a plow with revolving elements which throw the snow far out to the sides of the road, thus preventing the formation of deep, narrow lanes lined by walls of snow.

Gasoline Engine Power

Again last year the increasing popularity of the gasoline engine as the power unit for construction equipment was demonstrated. This was particularly the case with power shovels and cranes. Hoisting engines also felt the effect of this trend. The old prejudice against the gasoline engine due to the difficulty of starting it in cold weather is disappearing for the machine has been perfected to a stage which makes this trouble practically negligible.

Power units on construction equipment are being increased in capacity year by year. In the old days, a 15-hp. steam engine was standard equipment on a 21-E paver; today the 40-hp. gasoline engine is commonly used.

A study of contractors' plant layout last year brings out this significant fact: The fad for special or freak installations, usually of home-made design and construction, has largely disappeared and the constructor is turning to the manufacturer for *standard* equipment, of which there is today such an ample supply for all purposes that time and money are saved by planning work to make use of the machines and tools on the market and available for quick shipment.

Miscellaneous Improvements

AMONG other developments of the year the following are briefly noted as a preliminary to a more detailed discussion of the various types or classes of equipment and materials used by contractors and engineers: Portable machinery is being made tamper-proof by inclosure in metal housing as is the case with gasoline engines, compressors and pumps. Forced-feed lubrication has superseded grease cups in many instances. Mobility of the large, railroad-type steam shovels has been increased by the use of crawler traction or wide, heavy traction wheels. An 8-cu.yd. steam shovel was announced by one manufacturer.

Lightweight trenching machines for narrow shallow ditches have been among the year's new products. Attention has been given to the redesign of crawler tread for equipment to avoid cutting city pavements. Self-contained travelers have been designed for moving concrete forms on large-scale work. The loading and discharging of concrete mixers has been speeded up, and cableway excavators have been given a longer range of operations through the use of a two-speed hoist. Inclosed transmission has been a feature of some of the newer concrete mixers while inclosed gearing and other working parts have featured the development of clamshell buckets. One manufacturer has perfected a piledriving hammer for operation under water. Concrete road finishers have been designed for striking off at two different levels to provide for two-course work and also for paving with a top course of brick or asphalt on a concrete base. Concrete chuting equipment has been designed to handle the output of a 14-S, instead of a 7-S, mixer, which widens the field of application of this method of placing concrete.

The foregoing notes cover some of the high spots in the year's progress. For the purposes of more detailed description equipment and materials have been divided into a number of classes, each discussed below:

What Individual Manufacturers Have Contributed to the Year's Progress

Earth-Handling Equipment

Power Shovels — The past year demonstrated the growing popularity of gasoline-engine operated shovels as compared with steam or electric power. This trend is characterized by the Thew Shovel Co. as the outstanding feature of its experience in 1923, and for it the following reasons are ascribed: one-man operation; no coal and water to provide; no boiler to clean or flues to roll; no smoke. For units of the ¾ and 1-yd. revolving type convertibility into dragline, crane, and clamshell bucket rigs is general. The crawler type of mounting continues to be in demand and has been adopted by both the Marion and the Bucyrus organizations for their heavy-duty types of railroad shovel.

The Marion company designed for mine stripping a shovel with an 8-cu.yd. dipper capacity, capable of handling from 2,000 to 3,000 cu.yd. of material daily. This shovel can uncover 50 ft. of overburden in one cut. In its electric and gasoline-electric revolving shovels the Marion designs provide three separate motors for the three major operations of crowding, hoisting and rotating.

Bucyrus also announced a new large revolving shovel of the 350-ton type for stripping work at mines and large construction projects. One of the year's developments was the installation of Diesel engines on ¾-yd. revolving shovels and draglines.

Electric shovels in two new sizes, 1-yd. and ½-yd. were brought out by the Pawling & Harnischfeger Co. in addition to its ¾-yd. model. Osgood announced a new 1¼-yd. heavy-duty revolving steam shovel designed for mounting on continuous treads, traction wheels or railroad trucks. For its heavy railroad type shovel Osgood developed traction wheels to speed up moves and eliminate the pit crew for laying tracks and placing jack arms.

For its truck-mounted crane the Byers Machine Co. has introduced the Byers-Fogarty shovel attachment, which can be substituted for the material-handling crane boom. In this shovel, which has a ¾-yd. bucket, the crowding motion is accomplished by a ram which slides through rollers in a hollow boom like a telescope.

In the Koehring gasoline power shovel the main development of the year was an improvement in the crowding and racking-in transmission, allowing the boom to be raised or lowered by power without affecting any other functions of the machine. On the Bay City crane excavator a special double-locking device for the propelling mechanism was installed, making it possible to operate on a slope without blocking the wheels and also making it unnecessary to block the wheels on level ground to prevent the machine from pushing backward when digging.

Improvements in the Butler "shuveloder," manufactured by the Lake Superior Loader Co., decrease its weight to 3,600 lb. and make possible its use in such restricted quarters as a tunnel 5 ft. wide by 7 ft. high. The Hoar tunnel-mucking shovel has been redesigned to increase its dumping height; it now loads into a car 5 ft. 6 in. above the rail.

One of the year's interesting developments was the announcement by the Insley Manufacturing Co. of a gasoline shovel with ¾-yd. bucket operated by power from a Fordson tractor and convertible into a ½-yd. ditcher of the trench-hoe type or a ¾-yd. clamshell bucket outfit. In the Orton & Steinbrenner gasoline shovel the chief development of the year was a positive gear-driven crowding device for putting pressure on the dipper.

Several companies, including the Northwest Engineering Co., Bay City Dredge Works, and Erie Steam Shovel Co., put on the market during the year trench hoe attachments for their power shovels. They consist essentially of dipper arms and buckets which dig toward the machine instead of away from it, as in the case of a steam shovel.

* * *

Locomotive Cranes — One of the year's achievements was the building by the Industrial Works of a locomotive wrecking crane handling 200 tons at 17½ ft. radius. These units were ordered by the Virginian and the Norfolk & Western Rys. To operate within railroad clearances, the Orton & Steinbrenner Co. designed one of its cranes for mounting on a standard flat car which has a 6-ft. gage track laid upon it. In this outfit the swing of the turntable does not exceed clearances between tracks.

A new feature of both the Byers and the Universal cranes, ordinarily carried on motor truck chassis, was a continuous-tread mounting.

As many cranes are convertible into power shovels, reference should be made to the preceding section of this review for additional details.

* * *

Trench Excavators — Higher digging speeds and smaller over-all dimensions were the objects sought in changes of design of Parsons trench excavators. During the year the company announced a new model 40 to excavate to greater depth and width (40 in.) than formerly.

Attachments for increasing the width of cuts have been among the year's output. Among these devices is the rotary auxiliary cutter of the Buckeye Traction Ditcher Co. which consists of shafts with revolving cutters on either side of the boom. For other purposes than extremely heavy work, lightweight trenching machines have been put on the market by the Barber-Greene Co. and the Charles T. Topping Machinery Co. The equipment first named digs a trench 5 ft. deep and from 9 to 18 in. wide, and is intended for the use of utilities, such as gas, electric light and telephone companies, and general construction involved in water supply or sewerage. The Topping trencher is operated by Fordson tractor power. Its operating range is a ditch 12 to 22 in. wide and 5 ft. 10 in. deep.

* * *

Cableway Excavator—Through the use of a two-speed hoisting engine the operating range of the Sauerman cableway excavator has been increased to 1,300 ft. and buckets with a capacity of 3½ cu.yd. have been placed in successful service.

Compressors and Drills

In the field of pneumatic machinery Sullivan angle compound compressors have been improved by the use of the "wafer" type of air valve. A three-pass counter-current, high efficiency intercooler is now standard equipment on all sizes of compressor. The company also brought out a new differential valve water drifting drill, a one-man machine weighing only 130 lb.

A gasoline impact drill of the air hammer type, which is self-contained, portable and operated by one man, was developed by the Pennsylvania Gasoline Drill Co.; it weighs 70 lb.

To its line of drill-sharpening equipment, the Ingersoll-Rand Co. added a shank and bit punch in two types—one a self-contained machine and the other an attachment for a drill-sharpener.

Concrete Equipment

Building Mixers — Greater mobility was the objective sought by manufacturers in designs brought out during 1923 for mixers of the one-half or one-bag sizes. All of the leading mixer builders put on the market a machine on a rubber-tired wheel mounting in the form of a trailer, a four-wheel carriage, or a Ford automobile chassis. Small mixer rigs of this sort were developed by Chain-Belt, Archer Iron Works, Republic, Milwaukee, Knickerbocker, Lakewood, Smith, Marsh-Capron, Koehring, Ransome and Jaeger. In the Lakewood trailer outfit for one-bag capacity the rubber-tired wheels are supplemented by a spring suspension so that even when traveling behind a motor truck at 15 or 20 miles an hour there is comparatively little jarring. This type of trailer-mounted mixer is designed particularly for public utility companies whose work is in small units at widely separated points. Among the Ford automobile-mounted mixers are those of the Milwaukee Concrete Mixer Co. and the Archer Iron Works. For railroad work the Koehring Co. mounted its Dandie concrete mixer on flanged wheels for haulage on tracks by gasoline motor car.

On the larger sizes of machine a few improvements in details are recorded. Charging and discharging operations have been speeded up by improvements in the operating mechanism. The handling of water for mixers has been bettered by new measuring tanks, such as the Smith, and by the Koehring three-way valve which is automatically operated when the charging skip is raised.

The foregoing notes refer mainly to building mixers. Improvements in paving mixers will be dealt with in a second installment of this article to appear in the Highway issue of this journal next week.

* * *

Chuting Equipment — The introduction of stronger and heavier steel towers or masts has broadened the application of concrete chuting equipment. Steel is now largely used instead of wood for these structures. Last year's improvements showed substantial progress in standardization and interchangeability of parts for towers. Lakewood equipment is now made so that three distinct types of tower may be constructed from the same structural units. Insley masts are made in 20-ft. sections to accommodate height needed on jobs of various sizes. By the introduction of a strengthened front post in the Ransome equipment the entire distributing plant may slide up and down the mast; this is also a feature of the Insley outfit, which has been redesigned to handle the output of a 14-ft. mixer as compared with a 7-ft. mixer formerly used.

Added strength to the Lakewood standard tower enables the contractor to tie down the counterweight on a 100-ft. radius plant. The boom chute on the Insley equipment is suspended from a mast, carries the head section of a second 30-ft. chute, and provides a pouring radius of 60 ft. without recourse to floor supports. The sides of the Ransome tower are bull-riveted in the factory so that only the bracing in the front and back panels have to be bolted in the field. The trend toward heavier towers is indicated by the Ransome, which for a height of 180 ft. and a 36-ft. bucket weighs 34,000 lb.

A development noted by Lakewood is the 18-in. chute having four times the capacity and life of the standard chute. It is applicable to jobs requiring 200,000 to 300,000 yd. of concrete, and eliminates the expense of frequently dropping the standard chute line for relining purposes.

The material in this Review is based largely on replies received to an inquiry sent by "Engineering News-Record" to about 500 manufacturers of machinery and materials.

Concreting Accessories — For its batcherplant, for the measurement of charges of concrete aggregate, the Blaw-Knox Co. has developed two new fields: central mixing plants for building work and plants of sand and gravel dealers. A new feature is an automatic indicator which registers when the measuring batchers are filled. The company supplemented its batcherplant, last year, by a rapid cement loader with a four-leaf drop door, which makes possible the charging of hoppers, trucks, or cement pockets with a minimum of dusting and no loss of cement. This device eliminates all handling of cement at the mixer.

For handling steel forms on concrete construction a Blaw-Knox traveler has been developed to move the forms forward. It is a self-contained unit driven by a gasoline engine and is particularly adapted to tunnel, sewer and conduit jobs.

Pipe

In the field of cast-iron pipe the only prominent feature was the enlarged production of centrifugally cast pipe by the United States Cast Iron Pipe & Foundry Co. Other manufacturers report no essential changes in their product, although at a number of plants manufacturing facilities are being enlarged.

Centrifugally cast pipe of reinforced concrete was perfected by the Lock-Joint Pipe Co. A special lead and steel joint for large-size concrete pressure pipe was developed which enables laying to be done at a rapid rate, the pipe backfilled, and the lead joints calked from the interior *after* the pipe is in place. The Newark Concrete Pipe Co. reports the adoption during the year of a plain slip joint, with a slightly sloping surface, which makes a practically water-tight connection without any sealing material. In this joint the spigot ring is machined accurately to fit the ring used for molding the bell.

In the vitrified pipe field the W. S. Dickey Clay Manufacturing Co. has put on the market a triple-strength glazed clay culvert pipe designed to withstand the loads imposed by motor trucks using the highways. It was tested and showed a crushing strength of 6,000 lb. per linear foot for a 24-in. pipe with walls 2½ in. thick.

Hoists

An increase in the use of gasoline-operated hoists occurred last year. In addition to hoists receiving power from a Fordson tractor, the Clyde Iron Works produced a gasoline builders' hoist with reversible elevator sheave, the drum being non-reversible. With a double-drum outfit four kinds of hoisting can be accomplished on one job: The elevator sheave handles a double-cage material elevator; one hoist drum handles a lumber cage; another hoist drum handles a concrete tower; and the winch head handles steel beams and snakes material along the ground.

On the Novo hoist an auxiliary drum is now available for addition to a double-drum hoist for operating derricks. On the Mundy hoists silent-chain drives were adopted as standard and non-burning friction blocks of asbestall were substituted for wood. For installation on a mast, a double-drum, two-speed electric hoist was developed by the John T. Horton Co; it is equipped with a 7½-hp. motor and will handle a load of 6,000 lb. at 20 ft. per minute on a single line. To its line during the year the National Hoisting Engine Co. added a high-grade small hoist with most of the features of larger equipment; it can be made either a single or a double-drum outfit by bolting up a second drum unit.

Gasoline Engines and Turbines

Gasoline engines of a wide variety of types and sizes are now available for operating practically every kind of construction equipment. Contractors are indicating a clear preference for this kind of power in comparison with steam or electricity. The Buda Co. during the last year and a half has developed a line of gasoline engines for all industrial uses requiring not more than 60 hp. Special pumps driven by Buda engines have been designed to operate against a 900-lb. per square inch pressure in case of a break in an oil pipe line. High tension magnetos, instead of batteries and coils, have been made standard equipment on all single-cylinder Novo engines of from 1½ to 10 hp. The same practice is followed in the Witte engine which has been redesigned to provide for a throttling governor.

In the Diesel engine field the Fulton Iron Works have adopted an improved cylinder head which permits free expansion and contraction of the metal exposed to the intense heat of the combustion chamber. The Automatic Machine Co. developed a heavy-oil engine having substantially the lightness, flexibility and speed of the gasoline engine.

Kerr steam turbines have been improved by a change in bucket construction in which extremely thin inlet and exit edges reduce losses of steam entering and leaving the bucket. Reduction-gear lubrication has been improved by the employment of fan-shaped sprays which flood the teeth with oil to reduce wear. Developments in De Laval steam turbines were characterized by the utilization of higher steam pressures, and superheats and the use of exhaust steam for heating buildings. The rubber bushing type of flexible coupling was standardized.

A new high power runner for a hydraulic turbine was announced during the year by the S. Morgan Smith Co.

> This Review consists of two parts. General construction equipment and materials are considered herewith, while road-building plant will be discussed next week in this journal's annual Highway Number.

Meters

In the Venturi type of meter the Builders Iron Foundry has improved the legibility of dials and scales by using a black oxidized finish with white enamel figures and letters. Venturi boiler feed-water meters have been adapted for increased boiler pressures and designs are complete for pressures up to 1,000 lb. per square inch. A new speed changing device is being offered for use with dry chemical feed machines and filter plants to introduce the chemical in proportion to the flow of water through a Venturi tube. Last year the Simplex Valve & Meter Co. was called upon to supply Venturi type meters for a constant working head of over 1,000 lb. per square inch; this problem was solved successfully by the use of special gun metal for the main parts of the meter register.

For use in warm climates the Pittsburgh Meter Co. developed a new model known as the Tropic, having an all bronze outer case and connection spuds on the lower case. The interior mechanism consists of a two-piece measuring chamber which snaps together without the use of screws.

Buckets

Complete inclosure of working parts featured the bucket design of the Wellman-Seaver-Morgan Co. last year. Blaw-Knox used an alloy steel to reduce wear in bearings and also built an exceptionally large bucket weighing 22,000 lb. empty for government dredging work having a capacity of 7 cu.yd. A line of special lightweight clamshells was manufactured in three sizes —1, ¾, and ½-yd—by the G. H. Williams Co.; the 1-yd. bucket weighs only 2,650 lb. In the Mead-Morrison universal grab-bucket the lever arm is equipped with removable counterweights for different services; another feature of the design allows the shell to be removed in the field.

Building Equipment and Supplies

Its motor-operated steel rolling door for warehouse and industrial buildings was improved by the Kinnear Manufacturing Co.; its movement is controlled by limit switches and magnetic brakes and the operating equipment is designed, if desired, for unit operation of a group of doors.

For flooring in industrial establishments, Carter "bloxonend" were improved to allow for their installation over a concree slab without using embedded sleepers or nailing strips; this end is accomplished by a lateral nailing method.

A corner-cut block for flooring purposes which provides a duct for the application of dressing of pitch was the contribution of the Republic Creosoting Co.; it eliminates disadvantages of lugs, grooves, and other types of blocks.

For speedy repairing of broken concrete floors Quickfix, a compound made by the Master Builders Co., was put on the market. With it, the hardening process requires only 48 hr. A new cement-roof tile machine, automatic in operation, was brought out by the Atrax Corp.

The stability of the Pennsylvania joint manufactured by the Asphalt Products Co. has been increased by the addition of fibre which holds the bituminous material in shape under conditions of extreme heat.

Ruberoid utility paint was a new product marketed last year by the Ruberoid Co. It is designed for use in connection with roof coating. A bitumen-retardant paint, known as Bituseal, was announced by the Cheesman-Elliott Co. to prevent the staining of light paint when applied over tar.

By the use of alloys in steel and copper, the American Sheet & Tin Plate Co. produced sheet metals of high rust-resisting qualities.

(To Be Concluded Next Week)

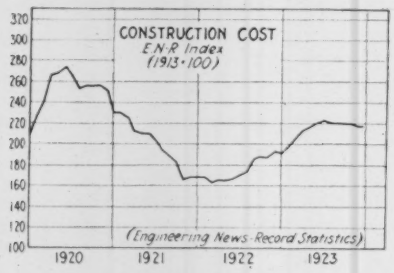
Business Side of Construction

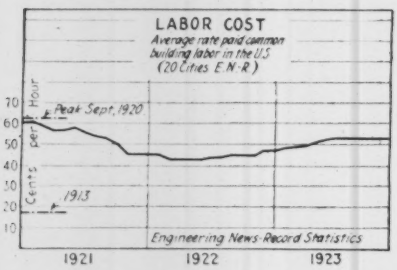
FACTS AND EVENTS THAT AFFECT COST AND VOLUME

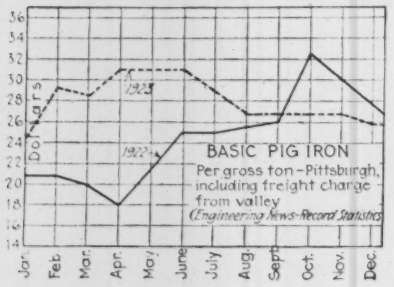
The Construction Barometer

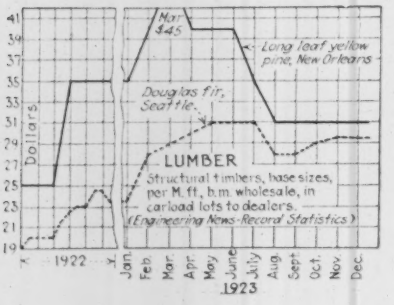
Present Seasonal Drop in Cost Will Probably Develop Into Rise When Winter Demand Causes Materials Scarcity in Spring

THERE has been a gradual downward trend in the volume of construction and in the cost of materials since September, 1923. This condition is, of course, almost entirely seasonal. The cost of labor, however, shows no tendency to recede. In fact, 1923 rates or higher will evidently dominate the skilled building trades situation during the coming year. Iron, steel, cement, lumber and other basic materials are higher now than a year ago. The rise in steel is more pronounced than that of iron, and the advance in fir timbers greater than that of either of the other two. Cement, however, is only about 5c. per bbl. above the January, 1923, level; while brick, after slight fluctuations, is practically the same now as one year ago. The recent downward turn in pine lumber and cement has had the effect of inducing greater interest in January and February construction. An unusual winter demand may seriously affect the materials market when the spring rush begins, despite the fact that mills are endeavoring to keep ahead of demand in order to prevent an abrupt rise in prices after Mar. 1, 1924.









CONTRACTS AWARDED, U. S. AND CANADA

Month	1923	1922
January	$142,599,000	†$78,550,000
February	123,742,000	†51,062,000
March	*240,349,000	*†178,427,000
April	198,665,000	†124,760,000
May	*218,712,000	†171,556,000
June	188,786,000	*182,342,000
July	163,459,000	119,173,000
August	*141,599,000	*160,130,000
September	173,072,000	138,648,000
October	161,276,000	137,877,000
November	*156,140,000	*134,697,000
December	126,221,000	123,143,000
Total	$2,034,620,000	$1,600,365,000

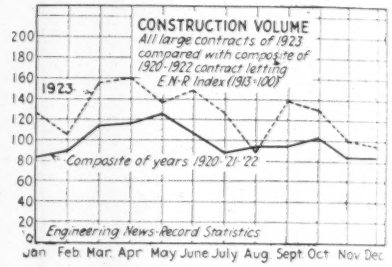
* Five issues of E.N.-R. † Does not include Canada

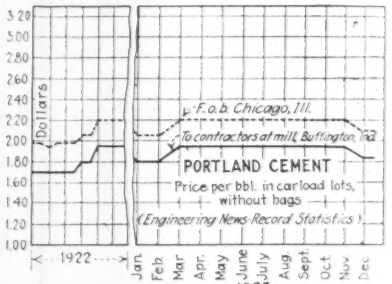
PRIVATE AND PUBLIC AWARDS, U. S. SINCE APRIL, 1923

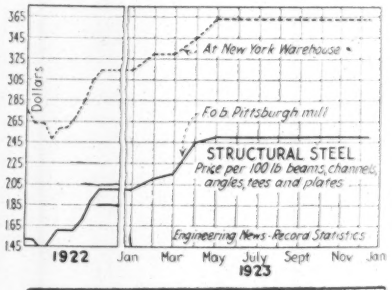
Month	Public Work	Private Work	Total Contracts
April	$74,913,000	$112,760,000	$187,673,000
May	98,618,000	93,114,000	191,732,000
June	79,833,000	92,760,000	172,593,000
July	82,536,000	72,487,000	155,023,000
Aug.	75,117,000	53,041,000	128,158,000
Sept.	84,540,000	82,600,000	167,140,000
Oct.	58,835,000	94,234,000	153,069,000
Nov.	61,162,000	90,785,000	151,947,000
Dec.	55,816,000	69,989,000	124,805,000
Total	$671,370,000	$760,770,000	$1,432,140,000

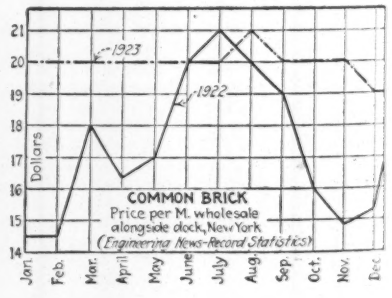
LETTINGS IN U. S. BY CLASSES AND ACCORDING TO GEOGRAPHICAL LOCATION

		Jan.	Feb.	Mar.
Water-works	N. E.			$264,000
	M. A.	$1,094,000	$481,000	10,595,000
	So.	313,000	155,000	130,000
	M. W.	151,000	743,000	2,618,000
	W. M.	3,068,000	1,311,000	1,166,000
	F. W.	36,000	40,000	137,000
Sewers	N. E.			
	M. A.	60,000	769,000	721,000
	So.	96,000	157,000	7,000
	M. W.	1,717,000	475,000	2,522,000
	W. M.	501,000	579,000	803,000
	F. W.	571,000	151,000	257,000
Bridges	N. E.	95,000	429,000	25,000
	M. A.	1,023,000		3,001,000
	So.	1,090,000	332,000	482,000
	M. W.	597,000	370,000	292,000
	W. M.	2,545,000	1,552,000	1,735,000
	F. W.	150,000	40,000	186,000
Streets and Roads	N. E.		647,000	153,000
	M. A.	2,814,000	294,000	5,439,000
	So.	3,085,000	3,330,000	7,837,000
	M. W.	3,023,000	7,897,000	7,695,000
	W. M.	9,923,000	4,383,000	12,860,000
	F. W.	2,846,000	1,972,000	3,538,000
Industrial works	N. E.	2,775,000	530,000	3,235,000
	M. A.	3,371,000	2,904,000	4,773,000
	So.	1,395,000	130,000	1,983,000
	M. W.	12,751,000	3,994,000	12,062,000
	W. M.	3,731,000	778,000	3,810,000
	F. W.	485,000	568,000	2,784,000
Buildings	N. E.	7,867,000	1,850,000	7,167,000
	M. A.	26,498,000	24,506,000	26,775,000
	So.	2,501,000	5,289,000	4,004,000
	M. W.	20,226,000	23,349,000	22,073,000
	W. M.	4,419,000	11,342,000	10,844,000
	F. W.	5,294,000	10,866,000	9,673,000

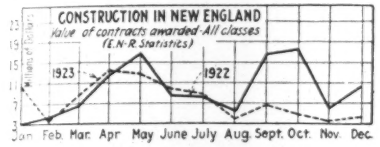

CONSTRUCTION VOLUME
All large contracts of 1923 compared with composite of 1920-1922 contract letting
E.N-R Index (1913-100)
1923
Composite of years 1920-'21-'22
Engineering News-Record Statistics
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

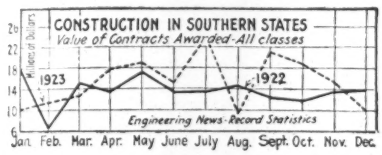


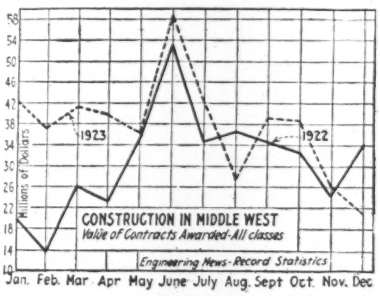


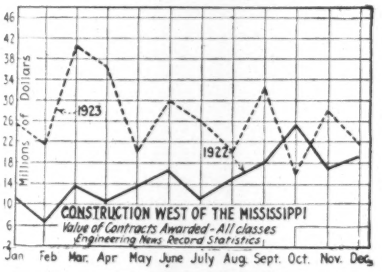


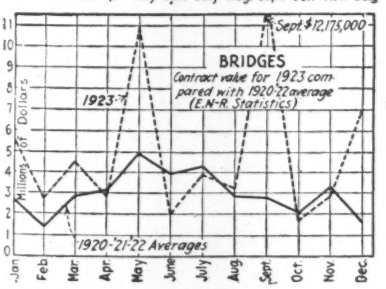
1923
1922
CONTRACTS AWARDED
in the United States
Engineering News Record Statistics
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

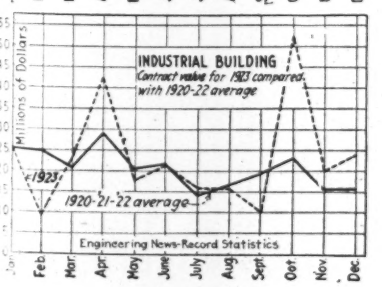

CONSTRUCTION IN NEW ENGLAND
Value of contracts awarded-All classes
(E.N-R Statistics)
1923
1922
Millions of Dollars
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


CONSTRUCTION IN SOUTHERN STATES
Value of Contracts Awarded-All classes
1923
1922
Millions of Dollars
Engineering News-Record Statistics
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

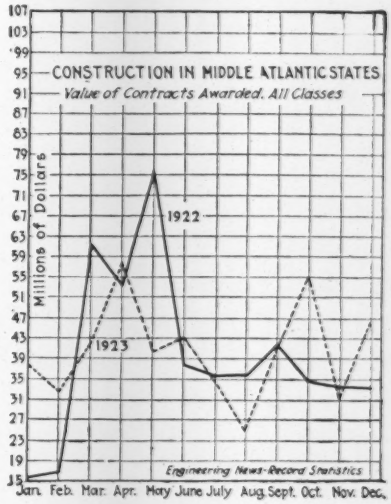

1923
1922
CONSTRUCTION IN MIDDLE WEST
Value of Contracts Awarded-All classes
Engineering News-Record Statistics
Millions of Dollars
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


1923
1922
CONSTRUCTION WEST OF THE MISSISSIPPI
Value of Contracts Awarded - All classes
Engineering News Record Statistics
Millions of Dollars
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

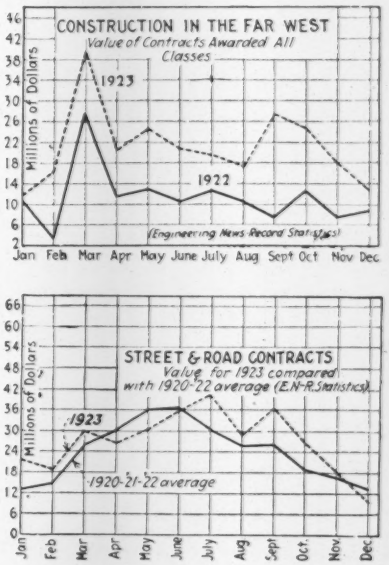

Sept $12,175,000
BRIDGES
Contract value for 1923 compared with 1920-22 average (E.N-R. Statistics)
1923
1920-21-22 Averages
Millions of Dollars
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec


INDUSTRIAL BUILDING
Contract value for 1923 compared with 1920-22 average
1923
1920-21-22 average
Millions of Dollars
Engineering News-Record Statistics
Feb Mar Apr May June July Aug Sept Oct Nov Dec

		April	May	June
Water-works	N. E.	$152,000	$120,000	.....
	M. A.	5,063,000	2,244,000	$198,000
	So.	1,207,000	231,000	253,000
	M. W.	987,000	1,445,000	2,031,000
	W. M.	934,000	475,000	1,160,000
	F. W.	151,000	2,457,000	186,000
Sewers	N. E.	116,000	167,000	295,000
	M. A.	1,672,000	3,746,000	2,360,000
	So.	251,000	414,000	567,000
	M. W.	2,830,000	3,502,000	2,459,000
	W. M.	370,000	500,000	493,000
	F. W.	258,000	533,000	249,000
Bridges	N. E.	25,000	858,000	28,000
	M. A.	503,000	137,000	154,000
	So.	420,000	660,000	178,000
	M. W.	714,000	892,000	518,000
	W. M.	1,163,000	706,000	913,000
	F. W.	104,000	10,395,000	241,000
Streets and Roads	N. E.	451,000	1,316,000	1,201,000
	M. A.	4,200,000	6,417,000	5,538,000
	So.	5,548,000	10,402,000	6,354,000
	M. W.	6,734,000	9,215,000	12,202,000
	W. M.	7,712,000	5,471,000	7,352,000
	F. W.	2,315,000	5,446,000	2,984,000
Indus-trial works	N. E.	4,562,000	3,575,000	1,755,000
	M. A.	13,490,000	3,537,000	1,648,000
	So.	673,000	1,399,000	1,970,000
	M. W.	7,367,000	6,195,000	6,969,000
	W. M.	11,605,000	5,893,000	7,183,000
	F. W.	5,334,000	2,251,000	1,857,000
Build-ings	N. E.	6,650,000	9,908,000	6,516,000
	M. A.	27,263,000	30,238,000	25,198,000
	So.	9,094,000	6,600,000	3,923,000
	M. W.	15,177,000	22,763,000	31,744,000
	W. M.	12,195,000	4,786,000	8,299,000
	F. W.	7,371,000	7,232,000	5,998,000


CONSTRUCTION IN MIDDLE ATLANTIC STATES
Value of Contracts Awarded, All Classes
1922
1923
Millions of Dollars
Engineering News-Record Statistics
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

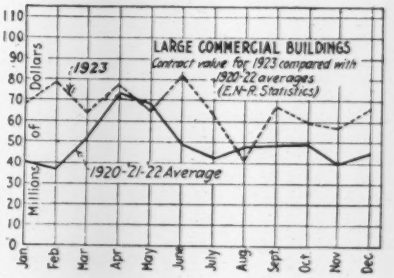
		July	Aug.	Sept.
Water-works	N. E.	.....	$135,000	.....
	M. A.	$612,000	208,000	$211,000
	So.	195,000	152,000	40,000
	M. W.	1,925,000	1,648,000	1,970,000
	W. M.	867,000	1,012,000	327,000
	F. W.	59,000	42,000	281,000
Sewers	N. E.	.....	.....	40,000
	M. A.	884,000	2,194,000	686,000
	So.	194,000	455,000	765,000
	M. W.	706,000	7,617,000	7,000,000
	W. M.	939,000	595,000	1,351,000
	F. W.	196,000	2,743,000	526,000
Bridges	N. E.	780,000	102,000	1,107,000
	M. A.	526,000	1,049,000	767,000
	So.	800,000	672,000	3,324,000
	M. W.	702,000	1,617,000	1,504,000
	W. M.	803,000	308,000	589,000
	F. W.	330,000	500,000	4,884,000
Streets and Roads	N. E.	1,435,000	1,075,000	1,740,000
	M. A.	8,649,000	9,189,000	9,962,000
	So.	6,268,000	7,310,000	6,033,000
	M. W.	11,691,000	6,748,000	6,165,000
	W. M.	8,148,000	7,356,000	8,501,000
	F. W.	4,495,000	3,161,000	4,500,000
Indus-trial works	N. E.	1,308,000	895,000	2,045,000
	M. A.	3,215,000	2,515,000	1,360,000
	So.	1,936,000	476,000	643,000
	M. W.	5,105,000	3,795,000	3,890,000
	W. M.	3,090,000	3,407,000	1,485,000
	F. W.	609,000	1,791,000	761,000
Build-ings	N. E.	5,177,000	2,005,000	1,413,000
	M. A.	9,708,000	11,818,000	23,209,000
	So.	7,683,000	1,926,000	4,509,000
	M. W.	20,943,000	11,750,000	10,530,000
	W. M.	8,314,000	9,616,000	11,114,000
	F. W.	10,909,000	11,991,000	15,579,000

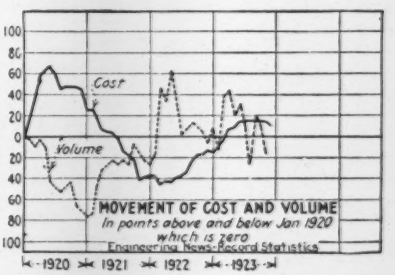

CONSTRUCTION IN THE FAR WEST
Value of Contracts Awarded All Classes
1923
1922
Millions of Dollars
(Engineering News-Record Statistics)
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

STREET & ROAD CONTRACTS
Value for 1923 compared with 1920-22 average (E.N-R Statistics)
1923
1920-21-22 average
Millions of Dollars
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

		Oct.	Nov.	Dec.
Water-works	N. E.	$187,000	$89,000	.....
	M. A.	125,000	328,000	261,000
	So.	15,000	218,000	299,000
	M. W.	184,000	3,436,000	488,000
	W. M.	409,000	1,656,000	283,000
	F. W.	2,592,000	507,000	341,000
Sewers	N. E.	.....	58,000	51,000
	M. A.	2,114,000	421,000	210,000
	So.	300,000	24,000	735,000
	M. W.	1,345,000	1,225,000	282,000
	W. M.	615,000	1,358,000	239,000
	F. W.	408,000	368,000	93,000
Bridges	N. E.	27,000	216,000	.....
	M. A.	587,000	544,000	4,209,000
	So.	50,000	1,247,000	841,000
	M. W.	306,000	829,000	205,000
	W. M.	538,000	441,000	1,217,000
	F. W.	285,000	2,507,000	27,000
Streets and Roads	N. E.	994,000	612,000	67,000
	M. A.	5,101,000	2,184,000	1,536,000
	So.	4,911,000	6,408,000	8,632,000
	M. W.	5,097,000	4,188,000	3,155,000
	W. M.	6,672,000	6,015,000	5,324,000
	F. W.	3,817,000	4,099,000	2,005,000
Indus-trial works	N. E.	905,000	705,000	2,520,000
	M. A.	22,670,000	2,665,000	5,245,000
	So.	1,476,000	840,000	795,000
	M. W.	19,250,000	6,700,000	5,365,000
	W. M.	1,088,000	12,407,000	3,321,000
	F. W.	3,546,000	1,724,000	2,751,000
Build-ings	N. E.	2,335,000	2,320,000	2,286,000
	M. A.	21,421,000	27,951,000	28,544,000
	So.	7,611,000	8,026,000	3,381,000
	M. W.	10,076,000	15,685,000	13,038,000
	W. M.	4,964,000	8,455,000	9,497,000
	F. W.	13,031,000	8,324,000	11,296,000

Note—N. E., New England; M. A., Middle Atlantic; So., Southern; M. W., Mid. Western; W. M., West of Mississippi; F. W., Far West.


LARGE COMMERCIAL BUILDINGS
Contract value for 1923 compared with 1920-22 averages (E.N-R. Statistics)
1923
1920-21-22 Average
Millions of Dollars
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec


Cost
Volume
MOVEMENT OF COST AND VOLUME
In points above and below Jan 1920 which is zero
Engineering News-Record Statistics
1920 1921 1922 1923

E. N.-R. Construction Volume Index Number

The *Engineering News-Record* Volume Index Number, placing the value of contracts let on a 1913 purchasing basis, was announced in the issue of Oct. 20, 1921, p. 670. Its purpose is to show the actual amount of contracts let in prewar years rather than the actual money value of contracts let. It is based on 1913—despite the fact that this was a sub-normal construction year by fifteen to twenty-five per cent—for two reasons: 1913 is the last prewar year and most index numbers (including *News-Record's* Construction Cost Index Number) are based on a 1913 basis. The year 1913 was normal neither as regards the volume of construction nor the monthly distribution as shown by contracts awarded. To correct the latter condition current monthly volumes are compared with the average monthly value of contracts let in 1913. As an example the value of contracts in December, 1913, which was $63,341,000, is not compared with the value of contracts let in December, 1923, which was $126,221,000 but with the average monthly value in 1913, which was $57,545,000.

Letting C represent the value of contracts let in 1913 (or any fraction of 1913), C_1 the value for 1923 (or the same fraction of 1923), I the *Engineering News-Record* Construction Cost Index Number for all or the considered part of 1913, and I_1 the Cost Index for all or the same part of 1923, the formula for computing the Volume Index Number is:

$$Vol.\ Index\ No. = \frac{\frac{C_1}{I_1}}{\frac{C}{I}} = \frac{IC_1}{I_1C}$$

But I and C are constants—100 and $57,545,000 (for any month of 1913) or 100 and $690,540,000 for the whole of 1913, therefore,

$$Yearly\ Vol.\ Index\ No. = \frac{C_1}{575{,}450I_1}$$

$$Yearly\ Vol.\ Index\ No. = \frac{C_1}{6{,}905{,}400I_1}$$

E. N.-R. Construction Volume Index Number

(1913 = 100)

	1923	1922	1921	1920	1919
Jan.	126	91	41	146*	41*
Feb.	105	100	43	114	72
Mar.	195*	202*	88*	107	43
Apr.	160	150	86	142*	83
May	171*	179	90	107	85*
June	148	187*	117*	74	108
July	128	118	90	85*	137*
Aug.	111*	154*	94	65	116
Sep.	137	129	114*	85*	96
Oct.	127	127	109	73	224*
Nov.	125*	122*	101	51	58
Dec.	...	111	118*	58*	35

* Taken from five issues of *Engineering News-Record* during month.

E. N.-R. Construction Cost Index Number

Engineering News-Record's Construction Cost Index Number is a national index of general construction cost in the United States. For that reason in its computation only the great basic materials and common labor are considered. Steel cement and lumber are the fundamental materials of the construction industry, and the rate paid ommon labor eventually determines the cost of labor.

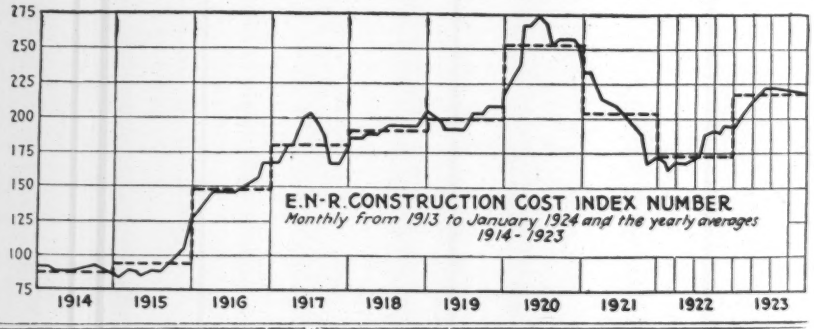
The importance of the cost of brick, sand, gravel, crushed stone, and the rest, is not minimized; but these materials are usually produced locally and their prices are subject to fluctuating local conditions.

The *Engineering News-Record* Construction Cost Index Number is not referred to Boston or Seattle, to Minneapolis or El Paso, but to the 3,507,640 sq.mi. of the United States. Change in towing rates on the Hudson River will affect the price of brick or crushed stone, alongside dock, New York, without making any change whatever in the nationwide cost of construction. On the other hand, a price movement in either steel, cement or lumber wields an influence that is almost invariably continental in scope.

The *Engineering News-Record* Construction Cost Index Number is based on the prices of steel, cement, lumber and common labor in 1913. Furthermore, these materials and common labor are weighted according to their relative importance as adjudged by *Engineering News-Record*. These weightings are: Steel, 37.50 per cent; cement, 7.14 per cent; lumber, 17.10 per cent; labor, 38 per cent. The weightings were determined by studying the annual production of the three prime materials and the number of common laborers (exclusive of farm labor) in the United States. The markets considered are structural steel in Pittsburgh, cement without bags f.o.b. Chicago; 3 x 12-in. to 12 x 12-in. Southern pine to contractors in New York, and the average price of common labor in the eighteen to twenty cities listed in the *Engineering News-Record* in the first issue of each month. The prices are those obtaining in the last week of each month and published in the first issue of each month. The quantities of these materials and the number of man-hours used in computing the Index Number were selected so that the total cost (quantities multiplied by prices, and added together) for 1913 would be $100 for a "unit of construction."

For example, if the quantities are 2,500 lb. of structural steel, six barrels of cement, 600 ft. b.m. of lumber, and 200 man-hours, and the prices are $1.50 per 100 lb. for shapes, $1.19 per net bbl. of cement, $28.50 per M ft. b.m. of lumber, and 19 cents per hour for common labor, the total computation will be $99.74; 100 is the base *Engineering News-Record* Construction Cost Index Number.

The accompanying tabulation gives the *Engineering News-Record* Construction Cost Index Number for every month from 1913 to December, 1923, while the chart gives both the monthly and yearly numbers. The current index number is presented in its regular form on p. 44 of this section.



Engineering News-Record Construction Cost Index Number—1914 to 1923

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
January	89.22	87.12	130.46	167.75	184.51	198.05	206.55	230.87	168.72	191.70
February	89.22	87.36	134.46	167.75	184.51	201.50	225.10	230.67	168.72	197.40
March	88.97	87.66	142.96	175.66	184.51	198.05	240.85	224.27	162.04	205.25
April	87.97	90.16	147.31	183.41	186.01	191.25	265.20	213.07	164.72	213.50
May	88.62	90.16	148.86	187.61	186.01	191.25	268.90	210.82	164.62	216.70
June	87.87	88.96	146.51	199.26	186.31	191.85	273.80	209.82	166.62	220.70
July	88.12	90.51	145.76	204.01	188.65	193.65	265.65	203.82	169.70	222.10
August	90.11	91.76	146.56	198.41	193.85	196.65	252.00	103.07	173.40	221.50
September	90.36	93.01	149.56	190.31	193.85	202.85	255.20	188.27	185.00	221.50
October	88.51	96.16	152.91	167.11	193.85	202.25	255.20	182.57	188.60	220.30
November	87.26	101.06	155.66	166.51	193.55	206.85	255.32	166.32	188.60	220.90
December	86.51	107.06	167.15	167.11	194.75	206.85	251.62	167.82	192.60	217.30
Averages	88.56	92.58	147.35	181.24	189.20	198.42	251.28	201.78	174.45	214.07

Prices of Construction Materials During April, May and June of Each Year Since 1913

A COMPARISON of spring prices of construction materials has been published in *Engineering News-Record* once a year since 1919. The accompanying tabulation brought to date is the same as last year's, with the addition of 1917 prices on reinforcing bars, steel sheet piling and hollow tile. On the last mentioned material prices have also been added for 1916.

The dimensions for hollow tile are based on 8 x 12 x 12, in this year's tabulation as against 6 x 12 x 12, formerly.

Raw linseed oil was the only one of the basic materials to show a decline Dec. 13, 1923, compared with the general average of spring prices since 1913. This material is barometrical of the paint trade and shows a drop of 12 per cent.

Steel structurals, at the Pittsburgh mill, showed a gain of 4 per cent, while building sand and cast-iron pipe each advanced 34 per cent when prices, as of Dec. 13, 1923, were compared with the average of spring prices during the last ten years.

On Dec. 14, 1922, linseed oil stood 7 per cent below the general average of spring prices, 1913 to 1922; structural shapes at Pittsburgh mill were 16 per cent and reinforcing bars 12 per cent below the 1913-22 average.

Tank plates, at New York warehouses, showed an advance of 3 per cent; reinforcing bars, 26 per cent and gravel, f.o.b. New York, 28 per cent, Dec. 14, 1922.

The per cent change on Dec. 15, 1921, however, showed a greater number of declines. Steel shapes at New York had declined 18 per cent; tank plates, 11 per cent; linseed oil, 27 per cent.

Price Situations in Spring, 1921, 1922 and 1923

(+ indicates increase; — indicates decrease)

Materials	Per Cent Change, March, 1921, from General Average of Spring Prices, 1913-1920	Per Cent Change, Dec. 15, 1921, from General Average of Spring Prices, 1913-1921	Per Cent Change, Dec. 14, 1922, from General Average of Spring Prices, 1913-1922	Per Cent Change, Dec. 13, 1923, from General Average of Spring Prices, 1913-1923
Crushed stone, New York	+ 61	+32	+22	+20
Sand, New York	+ 42	+27	+23	+34
Gravel, New York	+111	+14	+28	+23
Cast iron pipe, New York	+ 45	+ 9	+22	+34
Structural shapes, New York	+ 14	—18	+ 1	+16
Tank plates, New York	+ 17	—11	+ 3	+18
Linseed oil, New York	— 36	—27	— 7	—12
Freight Pittsburgh to New York or Chicago on finished steel products	+ 95	+76	+48	+41
Steel sheetpiling, Pittsburgh mill	+ 10	—18	+16	+ 5
Structural shapes, Pittsburgh mill	— 6	—39	—16	+ 4
Reinforcing bars, Pittsburgh mill	+ 6	+15	—12	+ 6
Reinforcing bars, New York warehouse	+ 11	—47	+26	+ 7
Average	+ 31	+ 1	+13	+16

Engineering News-Record Comparison of Spring Construction Materials Prices Since 1913

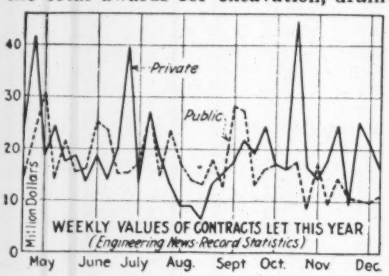
(All Prices New York Except Otherwise Stated)

	Portland Cement, per bbl. net, without bags, Chicago	Southern Pine, 12x12, 3x12 to 20 Ft. and Under	Common Brick (per M.)	Crushed Stone (per Cu.Yd., ¾ In.)	Sand (per Cu.Yd.)	Gravel (per Cu. Yd., ¾-in.)	C.-I. Pipe (6 In. per Ton)	Beams and Channels (3-15-In. per 100 lb.)	Beams, Etc., Pittsburgh Mill	Reinforcing Bars, 2-In. and Larger Pittsburgh Mill	Reinforcing Bars, ¾-In. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates, ¼-In. and heavier per 100 Lb.	Hollow Tile (8x12x12 per Block), Factory, Perth Amboy, N. J.	Linseed Oil (Raw in Barrels)	Freight to Pittsburgh on Steel (per 100 Lb.)	Average Common Labor Rate per Hr. for U. S.
April, 1913	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.102	$0.48	$0.16	$0.17
May, 1913	1.19	28.50	7.00	.90	.50	.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	.102	.50	.16	.17
June, 1913	1.19	28.50	7.00	.90	.50	.85	23.00	2.15	1.50	.150	2.25	1.60	1.61	.102	.48	.16	.17
Average	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$23.50	$2.15	$1.62	$1.50	$2.25	$1.60	$1.61	$0.102	$0.49	$0.16	$0.17
April, 1914	$1.12	$28.50	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.102	$0.54	$0.16	$0.18
May, 1914	1.12	30.00	5.50	.95	.50	.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	.102	.54	.16	.18
June, 1914	1.12	30.00	5.60	.95	.50	.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	.102	.53	.16	.18
Average	$1.12	$29.50	$5.55	$0.95	$0.50	$0.90	$21.50	$1.85	$1.13	$1.17	$2.25	$1.60	$1.31	$0.102	$0.54	$0.16	$0.18
April, 1915	$1.11	$28.50	$5.50	$0.90	.....	$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36	.....	.....	$0.169	.18
May, 1915	1.11	28.50	5.75	1.05	.....	.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32	.....	.....	.169	.18
June, 1915	1.15	26.50	6.00	1.05	.....	.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37	.....	.....	.169	.18
Average	$1.12	$27.75	$5.75	$1.00	.....	$0.85	$20.75	$1.90	$1.18	$1.17	$1.97	$1.53	$1.35	.....	.....	$0.169	$0.18
April, 1916	$1.42	$31.50	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50	.....	$0.81	$0.169	$0.18
May, 1916	1.46	31.50	7.25	.95	.40	.85	30.50	2.50	2.75	2.50	3.25	2.50	2.65	.....	.81	.169	.18
June, 1916	1.46	30.50	8.00	.95	.50	1.00	30.50	2.60	2.75	2.50	3.10	2.50	2.75	$0.085	.73	.169	.18
Average	$1.45	$31.00	$7.90	$0.95	$0.45	$0.90	$30.50	$2.55	$2.67	$2.47	$3.15	$2.50	$2.65	$0.085	$0.78	$0.169	$0.18
April, 1917	$1.76	$32.75	$9.50	$1.20	$0.50	$1.25	$47.50	$3.75	$3.88	$3.35	$4.60	$3.60	$5.00	$0.157	$1.04	$0.169	$0.28
May, 1917	1.90	34.75	11.50	1.25	.50	1.35	55.50	3.80	4.00	3.50	.....	3.60	5.50	.157	1.21	.169	.28
June, 1917	1.91	39.75	10.25	1.25	.50	1.25	55.50	5.00	4.31	3.50	5.10	3.60	7.00	.157	1.31	.169	.28
Average	$1.86	$35.75	$10.40	$1.25	$0.50	$1.30	$51.70	$4.15	$4.06	$3.45	$4.85	$3.60	$5.80	$0.157	$1.19	$0.169	$0.28
April, 1918	$1.96	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	$0.16	$1.55	$0.195	$0.37
May, 1918	1.96	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	.16	1.55	.195	.37
June, 1918	2.00	43.25	10.25	1.75	1.25	2.00	61.35	4.20	3.00	2.90	4.09½	4.00	4.45	.17	1.58	.195	.37
Average	$1.97	$43.00	$10.15	$1.75	$1.25	$2.00	$57.35	$4.20	$3.00	$2.90	$4.09½	$3.70	$4.45	$0.16	$1.56	$0.195	$0.37
April, 1919	$2.00	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.1944	$1.55	$0.27	$0.46
May, 1919	2.00	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	.1944	1.63	.27	.45
June, 1919	2.00	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	.1944	1.76	.27	.45
Average	$2.00	$45.50	$15.00	$1.75	$1.25	$2.00	$56.03	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.1944	$1.65	$0.27	$0.45
April, 1920	$2.00	$72.00	$18.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.3411	$1.87	$0.27	$0.55
May, 1920	2.08	70.00	18.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	.3411	1.87	.27	.57
June, 1920	2.15	70.00	18.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	.....	1.73	.27	.58
Average	$2.08	$70.50	$18.00	$2.10	$1.42	$2.58	$74.97	$4.83	$4.00	$3.92	$5.00	$3.65	$4.89	$0.3411	$1.83	$0.27	$0.57
April, 1921	$2.17	$48.00	$16.00	$1.95	$1.25	$2.50	$63.30	$3.33	$2.00	$2.00	$3.28	$2.55	$2.00	.....	$0.73	$0.38	$0.56
May, 1921	2.17	48.00	15.00	1.95	1.25	2.50	63.30	3.33	2.20	2.10	3.38	2.55	2.40	.....	.67	.38	.57
June, 1921	2.17	43.00	14.50	1.95	1.25	2.50	58.30	3.33	2.20	2.10	3.38	2.55	2.40	$0.1541	.80	.38	.58
Average	$2.17	$46.25	$15.00	$1.95	$1.25	$2.50	$61.60	$3.33	$2.15	$2.10	$3.35	$2.55	$2.25	$0.1541	$0.73	$0.38	$0.57
April, 1922	$1.97	$44.00	$16.25	$1.75	$1.00	$1.75	$47.30	$2.48	$1.50	$1.50	$2.58	$1.75	$2.48	$0.1789	.83	.38	.43
May, 1922	1.97	43.00	17.00	1.75	1.00	1.75	47.30	2.58	1.60	1.60	2.68	2.00	2.58	.1789	.91	.38	.42
June, 1922	1.97	43.00	20.00	1.75	1.00	1.75	49.30	2.58	1.60	1.60	2.68	2.00	2.58	.1789	.91	.38	.43
Average	$1.97	$43.33	$17.75	$1.75	$1.00	$1.75	$47.97	$2.55	$1.57	$1.57	$2.65	$1.92	$2.55	$0.1789	$0.88	$0.38	$0.43
April, 1923	$2.20	$58.00	$20.00	$1.75	$1.00	$2.25	$57.50	$3.44	$2.45	$2.35	$3.34	$2.50	$3.44	$0.2362	$1.13	$0.34	$0.50
May, 1923	2.20	60.00	20.00	1.75	1.25	2.25	58.50	3.44	2.50	2.40	3.34	2.60	3.44	.2691	1.16	.34	.51
June, 1923	2.20	60.00	20.00	1.75	1.25	2.25	63.00	3.64	2.50	2.40	3.54	2.65	3.64	.2691	1.16	.34	.53
Average	$2.20	$59.33	$20.00	$1.75	$1.16	$2.25	$59.66	$3.50	$2.48	$2.38	$3.40	$2.58	$3.50	$0.2581	$1.15	$0.34	$0.51
General Average	$1.73	$41.85	$11.99	$1.46	$0.928	$1.62	$45.95	$3.13	$2.39	$2.27	$3.30	$2.52	$3.09	$0.1732	$1.08	$0.24	$0.35
Dec. 13, 1923	$2.10	$52.00	$19.00	$1.75	$1.25	$2.00	$61.60	$3.64	$2.50	$2.40	$3.54	$2.65	$3.64	$0.1968	$0.95	$0.34	$0.54

Annual Review of Contracts Statistics

THE value of contracts let in the United States and Canada on important engineering projects as announced in *Engineering News-Record* for 1923 total $2,002,429,000. Awards in the United States for this same period amounted to $1,899,254,000, an increase of 22 per cent over 1922. This places 1923 ahead of any of the past five years and 283 per cent over 1913.

The totals for all classes of construction for 1923 are in excess of the same classes of last year. In fact all classes of the past year are in excess of the same classes of the years tabulated with the following exceptions: The year 1919 surpassed all the years given in the total awards for excavation, drainage and irrigation. The industrial contracts of 1920 are the greatest for the past 5 years and this class for the year 1919 also exceeds 1923. The Federal Government work during the year 1919 has not been equaled by any of the years tabulated.



Minimum costs recorded in Construction News, on each class of construction, are as follows: Waterworks, 15,000; other public works, $25,000; industrial construction, $40,000; Commercial buildings, $150,000. The total of all contracts awarded below these figures for the past year would place it as a banner year in construction.

Value of Contracts Let in the United States and Canada, Jan. 1, 1923, to Jan. 1, 1924

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	United States	Canada	Grand Total
Waterworks	$947,000	$21,420,000	$3,028,000	$17,626,000	$12,668,000	$6,829,000	$62,518,000	$1,772,000	$64,290,000
Sewers	727,000	15,837,000	3,965,000	31,680,000	8,207,000	6,353,000	66,769,000	1,714,000	68,483,000
Bridges	3,692,000	12,560,000	10,096,000	8,271,000	12,510,000	19,649,000	66,778,000	3,986,000	70,764,000
Excavation, drainage and irrigation		7,210,000	3,327,000	2,558,000	8,119,000	30,777,000	51,991,000	923,000	52,914,000
Streets and roads	9,691,000	61,323,000	76,118,000	83,810,000	89,717,000	41,178,000	361,837,000	19,260,000	381,097,000
Industrial works	24,800,000	67,393,000	13,716,000	93,443,000	57,798,000	24,461,000	281,611,000	14,210,000	295,821,000
Buildings	55,494,000	254,585,000	64,547,000	217,357,000	103,845,000	117,564,000	813,392,000	25,750,000	839,142,000
Federal government	901,000	10,855,000	12,215,000	8,067,000	6,084,000	9,818,000	47,940,000		47,940,000
Unclassified	2,875,000	36,789,000	17,952,000	22,817,000	43,938,000	22,047,000	146,418,000	35,560,000	181,978,000
Total 1923	$99,127,000	$487,972,000	$204,964,000	$485,629,000	$342,886,000	$278,676,000	$1,899,254,000	$103,175,000	$2,002,429,000

Last Five Years' Contracts Compared with 1913

Classification	1913	1919	1920	1921	1922	1923
Waterworks	$24,373,000	$19,761,776	$30,772,098	$40,602,948	$36,220,000	$62,518,000
Sewers	26,906,000	38,505,864	36,066,577	39,385,042	43,584,000	66,769,000
Bridges	23,290,000	27,143,669	35,213,881	27,330,677	45,477,000	66,778,000
Streets, roads	48,471,000	14,709,796	265,423,491	315,351,427	334,694,000	361,837,000
Excavation, drainage and irrigation		225,654,995	16,218,664	19,180,500	19,551,000	51,991,000
Industrial	49,104,000	381,192,655	482,200,884	114,256,054	198,141,000	281,611,000
Buildings	148,687,000	337,285,854	581,324,693	568,261,252	750,762,000	813,392,000
Federal government	39,405,000	72,375,400	35,281,531	26,607,391	43,552,000	47,940,000
Unclassified	135,303,000	59,257,494	99,501,217	60,395,674	86,569,000	146,418,000
Total	$495,542,000	$1,175,887,503	$1,582,013,036	$1,231,370,965	$1,556,550,000	$1,899,254,000

Value of Contracts Let in the United States and Canada, December, 1923

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Western	United States	Canada	Total
Waterworks		$261,000	$299,000	$488,000	$283,000	$341,000	$1,672,000	$19,000	$1,691,000
Sewers	$51,000	210,000	735,000	282,000	239,000	93,000	1,610,000	42,000	1,652,000
Bridges		4,201,000	841,000	205,000	1,217,000	27,000	6,491,000	78,000	6,637,000
Excavation, drainage, irrigation		182,000			116,000	92,000	390,000	60,000	382,000
Streets and roads	67,000	1,536,000	8,632,000	3,155,000	5,324,000	2,005,000	20,719,000	316,000	21,035,000
Industrial works	2,520,000	5,245,000	795,000	5,365,000	3,321,000	2,751,000	19,997,000		19,997,000
Buildings	2,286,000	28,544,000	3,381,000	13,038,000	9,497,000	11,296,000	68,042,000	758,000	68,800,000
Federal government	9,000	483,000	1,058,000	242,000		291,000	2,083,000		2,083,000
Unclassified	160,000	1,202,000	719,000	1,020,000	217,000	83,000	3,401,000	543,000	3,944,000
Total	$5,093,000	$41,864,000	$16,460,000	$23,795,000	$20,214,000	$16,979,000	$124,405,000	$1,816,000	$126,221,000

Engineering News-Record Construction Cost Index Number

January, 1924	**217.90**
December, 1923	217.30
January, 1923	191.70
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number gained 0.6 points since last month, owing to a slight advance in the price of lumber. Prices of other basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 14 per cent higher than one year ago and 20 per cent under the peak; it is 118 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

December, 1923 (4 *issues of E. N.-R.*)	**101**
November, 1923 (5 *issues of E. N.-R.*)	125
December, 1922 (4 *issues of E. N.-R.*)	111

Yearly

1923 (entire year)	135
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1919 (entire year)	91
1913 (entire year)	100

Engineering News-Record's Construction Volume Index Number is 101 for the month of December, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 101 for December, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

Country Not in Boom, Therefore No Slump Feared

Aside from Agricultural Difficulties, Situation Never Clearer Than At Present, According to Hoover

Secretary of Commerce Hoover, speaking before the Lumber Standardization Conference recently held at the Department of Commerce, made the following statement regarding present business conditions and the outlook for the immediate future:

I have always resisted the temptation to economic prophecy. We have a wag in this Department who checks the economic prophecies made by institutions throughout the country, and we find they are running from 50 to 75 per cent wrong, usually, so I will not enter into that very dangerous field.

But there are certain generalizations that one can safely make. The present is the platform for the future, and that platform has never been sounder than at the moment.

If we survey broadly the economic conditions of the various industries, we will find that there is employment at the highest known wage we have known in this country for many years; that there is, consequently, the largest buying power that we have seen in a decade; that there is, therefore, a demand for homes. Great construction activity prevails in the country as a result of our united savings.

There is truly some difficulty in some branches of agriculture. Agriculture has not as yet lifted itself to the economic levels of other industries, but it has shown distinct improvement in the past twelve months in its relative situation. Aside from that difficulty, we have never had a clearer situation than at the present moment.

I make that statement, because to me the fundamental of business stability is the absence of speculation; unless there is speculation current in the country, there is nothing to *collapse from.* We have no unusual stock of goods. In fact, we have probably a smaller stock of goods, take it by and large, than is often current. But commodities are moving swiftly from the producer to the consumer. There is no overbalance in our credit situation. There can be no slump without a boom. We are not in a boom, consequently I look for no great slump.

Now, the manufacturers call for caution. The situation in Europe is not encouraging from an economic point of view, and it is that very caution, combined with resolution, that has carried us through this year with extraordinary stability. I would hate to see that spirit of caution leave our people, because with the spirit of caution and the full employment of energy, we will not be precipitated into the wastes and dangers of booms, and, as I have said, without booms we will have no slumps.

Business Briefs

Call money firm, rate moving up to 6 per cent from opening and renewal at 5½.

Time money dull at 5 per cent.

Commercial paper trade light at 4¾ @5 per cent.

Foreign exchange unsettled. Sterling $4.34; last week, $4.34⅜; year ago, 4.63½. Franc, $0.0510; last week, $0.0510½; year ago, $0.0727.

Outlook for Labor Rates and Employment

ALTHOUGH reports of increasing unemployment in certain industries have been coming in of late, the construction industry is in a healthy state of activity owing to favorable weather and certain price concessions. *Engineering News-Record's* correspondents in various centers look with confidence toward 1924 and support their optimism with figures. On the other hand, it will not be denied that construction cost is very high. If it goes much higher the effect upon 1924 construction will be serious.

Building prospects and labor rates and conditions in the larger cities are as follows:

Atlanta—Majority of sub-contractors have enough business booked to carry them through the first six months of 1924. Labor situation satisfactory; plenty of help, with exception of plasterers and tilesetters. Plasterers getting as high as $1.50 per hr. Prospects never better than for 1924 building season.

Baltimore—Architects and engineers are now preparing plans for about $20,000,000 worth of new industrial and commercial buildings and the City plans to complete this year about $30,000,000 worth of schools, piers, etc. Altogether, authorities in building circles state that $70,000,000 will be spent in 1924 for new work. A $2,500,000 plant for the Standard Sanitary M'f'g Co. of Pittsburgh has been started and will be completed this year. It will be the largest plant of its kind in the East. Harmony reigns between employer and employee and will no doubt continue throughout 1924. There has been a shortage of skilled mechanics, particularly plasterers, which held up school construction. The present wage scale will probably prevail throughout 1924.

Birmingham—There are no strikes or other evidences of labor trouble in sight, and while 1923 has been a banner year in building construction, the work has been confined very largely to residence, appartments and stores. In spite of this the housing situation is still acute and the need of more office buildings and large stores is made apparent by excessive rents. Over $10,000,000 worth of new construction is now projected for the near future, and it would appear from the standpoint of the building trades and materials men that the year 1924 will be exceedingly prosperous.

Boston—Work rather slack owing to usual cold weather let down. This condition will continue for the next two months. Most of big jobs started in 1922 practically completed, but much new work consisting of municipal, state and private projects now under way for spring opening. The outlook, however, is not quite up to 1922 standards, although no serious labor trouble or immediate wage increase or reductions are anticipated. Materials are easier to get than for several years. In general the outlook points to a sound year for labor, contractors and owners.

Chicago—The outlook for 1924 in Chicago points to a volume of construction at least equalling last year's. Nearly all building trades mechanics have signified their intentions of asking for a wage increase of 25c. per hr. starting June 1. Shortage of mechanics has given rise to payment of present premium wage schedule.

Cleveland—There is little likelihood of any strikes or disputes over wages developing in Cleveland during 1924. Building crafts and employers have adopted the custom of getting together before May 1 of each year to settle all differences before the building season becomes too far advanced. This year the effort has been successful and preliminary meetings have already been held. Indications are that present rates will hold for 1924. There is no surplus of building labor in Cleveland with the shortage more marked in bricklayers and plasterers than in any other lines.

Denver—Employment in the building trades in Denver at the close of 1923 was about 75 per cent of normal on the average. The past year has been free from strikes of importance and the wage scales now in effect were adopted over the conference table in the spring of 1923. No changes are contemplated and the 1924 outlook is especially good. Labor leaders estimate that 90 per cent will be employed in the spring the remaining 10 per cent representing the floating idle labor generally found in the market.

Kansas City—A number of very large projects such as apartment, office and factory buildings, a new inter-urban station, a new Board of Trade building, and a pumping station costing over $22,000,000 are now under way. There is plenty of help in all grades but labor and employers' organizations are not working in harmony with each other. The cement finishers, for instance, who were recently granted an increase, are now demanding $1.25 per hr., effective March 1, otherwise a strike will be forthcoming. Plasterers, now getting $11 per day, are asking $14, with no Saturday, Sunday or holiday work. A strike seems imminent in this trade if the increase is not granted.

Los Angeles—There is much new construction already in sight for 1924. The year just past has been the best in Los Angele's building history.

Minneapolis—No clouds in the labor sky. There will be some working below scale this winter in the skilled trades, owing to seasonal increase in unemployment. No definite action toward fixing a 1924 wage scale will be taken before April. Labor may at that time resent any attempt at reduction.

Montreal—The industrial outlook for 1924 in Montreal is particularly bright. At least ten large office buildings will be constructed, with extensions contemplated for several large plants, mostly in the steel line.

The Trades and Labor Council expects no strikes and the current scale will prevail throughout 1924. There is no unemployment or tendency to strike among the building trades at present.

New York—Ratification of contracts between seven building trades' unions and the employers' associations practically guarantees peace in the building situation for the next two years. The remaining twenty-nine unions are expected to ratify the agreements sometime during the current month. The original demand of the unions was for a base pay of $11 per day, against $9 with a bonus of $1 per day. A compromise was reached placing the base pay at $10 per day for two years in most cases. This agreement will enable architects and builders to draw plans and figures on wages for at least eighteen months in advance. A record year in the construction industry is anticipated for 1924.

New Orleans—The carpenters strike begun July 16 and ended Dec. 10, resulted in a loss for the organized trade. The contractors won out with their offer of 90c. per hr. with open shop. Plasterers' wages were increased voluntarily by the sub-contractors, from $1 to $1.25 per hr. As the plasterers are chiefly negroes the whites will not work with them, hence the difficulty in replenishing the ranks of a trade where no apprentices are being taken on. The building program for 1924 looks good, as a number of big projects are being launched early in the season. Both skilled and unskilled labor is sufficient and the materials market is well supplied.

St. Louis—Building trades unions seek to raise the basic wage scale from $1.25 to $1.50 per hr. Financiers have been asked by the builders to withhold loans on new construction if the unions persisted in their demands. Chicago and Eastern financial interests, however, are advancing money for St. Louis construction and there are possibilities of victory for the mechanics. Because of the unsettled condition in the labor market it is feared that many big projects now contemplated will be temporarily withdrawn from the local market.

San Francisco—Building trades are still busily employed, with prospects of an active 1924 season. Unemployment among other classes is increasing because of the fact that the fruit harvests are all in and that transients from other sections are drifting in to enjoy the mild winter weather.

Unprecedented Transportation Achievements During 1923

Unprecedented achievements in meeting without difficulty the transportation needs of the country have been accomplished by the railroads of the United States during the year 1923.

Not only have the rail carriers successfully transported the greatest freight traffic in their history, but they have done so without any transportation difficulties whatever and with virtually no car shortage. They have also at the same time improved the physical condition of their rolling stock to the highest point in years.

As a result of a campaign inaugurated early last spring by the railroads in anticipation of a record breaking freight traffic this year, there was a noticeable increase in the earlier movement of various commodities which resulted in making available an increased amount of freight equipment for the crop movement in the late summer and fall months. This was especially noticeable in respect to the earlier movement of such commodities as coal and road building materials.

With complete reports available for the first forty-nine weeks—that is, from January 1 to December 8, inclusive—and estimates for the last three weeks of the year, loading of revenue freight in 1923 totaled approximately 49,844,000 cars, an increase of fifteen and two-fifths per cent over 1922 and ten and one-half per cent greater than in 1920 when freight traffic was the heaviest on record. Loadings in 1923 also exceeded the war period of 1918 by nearly twelve per cent and 1921 by almost twenty-seven percent.

During nine consecutive months this year, loadings have averaged more than a million cars weekly—a remarkable record in itself. The peak loading was reached during the week which ended September 29, when the total was 1,097,274 cars.

Price Outlook for Construction Materials

RECENT downward adjustments in prices of certain basic materials, such as cement and pine timbers, were designed principally to induce a greater volume of construction during the months of January and February. The resultant demand, however, closely followed by the regular spring rush will undoubtedly serve to advance prices to higher levels before the close of the first quarter. Present materials stocks are adequate, but the protracted demand will result in mills feeling the pinch, in making deliveries, by the time the height of the 1924 building season has been reached. There is no evidence of a tendency toward lower prices, either during this month or next; increased production is therefore the only factor making it possible to prevent much higher price levels during the next three months.

Pig Iron—No. 2 foundry now $22 per ton at Birmingham, against $23 one year ago. This grade can be had in large tonnages as low as $20@$21 per ton, owing to recent dullness of market. Present demand, however, is showing more signs of life in New York and Middle West than in other sections of the country.

Railway Supplies—Orders for track bolts and standard spikes fairly heavy at mills. Spikes, 25c. to 40c. per 100 lb. higher than year ago; standard rails, track bolts and angle bars, same price as in January, 1923. Tie plates and steel sheets also in good demand; car plate buying affected by foreign competition.

Pipe—Sustained strength in standard steel and wrought iron pipe markets. Cast-iron pipe prices tending lower; present levels, however, considerably above one year ago. Few fluctuations in sewer pipe or clay drain tile.

Road and Paving Materials—Road oils prices below year ago levels. Recent increases of from 10c. to 25c. per bbl. in crude oil, due to falling output, will probably affect 1924 schedules, in an upward direction. Price position of asphalt similar to that of road oils. Paving stone, flagging and curbing firm at present levels. Slight downward tendency in wood blocks in Boston and St. Louis. In other cities, however, trend is upward, owing to advancing prices in grades of lumber used in making blocks.

Sand, Gravel and Crushed Stone—Sand and gravel prices triple above year ago, in most cities; crushed stone, lower in greater number of cases. St. Louis and Philadelphia, however, report advances at beginning of new year.

Lime—Quotations remain firm in most cities. Boston, Dallas and Kansas City report declining markets; prices higher in St. Louis.

Cement—Although the general price range is slightly above that of one year ago, reductions, during the last two months of 10c. to 25c. per bbl. at mills and warehouses throughout the country, have been made for the purpose of stimulating interest in January and February construction. Present stocks are adequate; but with spring demand following close upon unusual winter building activity, higher prices are expected by March.

Steel—Buyers are evidently taking the attitude that prices will not decline during the first quarter of the new year. Steel sheet buying greatly increased during last month; demand principally from automobile, railroad and agricultural industries. Tin plate demand fairly heavy; prices unchanged. Bars still quoted at $2.40 base; shapes and plates, $2.50 per 100 lb., Pittsburgh. As low as $2.40, however, has been mentioned on shapes and plates. Most steel items are higher than year ago.

Brick and Hollow Tile—Brick in the majority of cases is higher now than in January, 1923. During the last month, however, slight declines have occurred in Boston and Philadelphia. Increased production has been met by a corresponding increase in demand. Hollow tile prices are fairly stable at levels a trifle under those of one year ago. Recent declines are reported in St. Louis, Boston and Cincinnati, with advances in Atlanta and Kansas City.

Lumber—A falling off in production, shipments and orders characterizes the lumber movement of the country at the beginning of the new year. This condition is seasonal, however, as orders and shipments are both a billion ft., and production nearly two billion ft. greater than during the same period last year. The recent cautious attitude of buyers was evidently due to a desire to close the year with light stocks. Although price declines exceed advances throughout the entire country at present, a reverse swing of the pendulum is expected after January.

Explosives—General tendency of market temporarily downward.

Scrap—Iron and steel scrap demand active; prices higher. Many foreign inquiries entering market.

Linseed Oil—Prices about 2c. per gal. under year ago, particularly along Atlantic seaboard. Recent turn in market has been upward, especially in Southern States.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—**Per Gross Ton**—Quotations compiled by The Matthew Addy Co.:

	Jan. 3	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25.05	$27.55
Northern Basic	24.00	28.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	24.00	29.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28.00	33.44
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	22.00	23.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	24.25	28.76
Virginia No. 2 (silicon 2.25 @ 2.75)	28.17	33.17
Basic	24.00	27.50
Gray Forge	24.00	28.14
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	24.50	28.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	27.00	28.51
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25.77	25.00
Basic	25.77	24.25
Bessemer	26.77	27.50

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	**$16.00**	$11.50	16@16.50
Stove plate	**13.00**	12.00	16.00
No. 1 machinery cast	**18.00**	16.50	19.50@20
Machine shop turnings	**9.00**	4.00	12.50@13.50
Cast borings	**10.00**	5.50	14.00
Railroad malleable	**16.00**	12.50	21.00
Re-rolling rails	**14.00**	13.00	21.50@22
Re-laying rails	.....	30.00	28.00@31
Heavy melting steel	**13.00**	16.00	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Jan. 3	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	.....	$43.00	**$46.00**
Standard openhearth rails	43.00	43.00	$43.00	43.00	**46.00**
Light rails, 8 to 10 lb.	45.00	40.00	2.00*	43.00	**2.55***
Light rails, 12 to 14 lb.	45.00	42.00	2.00*	43.00	**2.45***
Light rails, 25 to 45 lb.	45.00	42.00	2.00*	43.00	**2.35***
Rerolled Rails	37@40	28@30	.....	.....	2.10*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.70	$1.90
Chicago, Hardwood and Red Oak	1.35@1.45	1.50@1.70
Chicago....Empty Cell Creosoting (add'l)	.50	.60
San Francisco..... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted. Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.60
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.50
St. Louis, Sap pine-cypress	1.05	1.35

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Jan. 3	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.00@3.15	$2.75	$3.00	*$3.85*	$4.85	$3.72
Track bolts	4.00@4.25	3.75@4.50	4.00	*4.90*	6.20	4.57
Standard section angle bars	2.75	2.75	2.75	*3.45*	4.00	3.20

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York Jan. 3	New York One Year Ago
4 in.	$53.00	*$59.20*	$67.10@68.60	$54.50
6 in. and over	49.00	*55.20*	*61.60@63.60*	59.00
	Chicago	St. Louis	San Francisco	
4 in.	$60.20@64.20	*$56.00*	*$61.00*	
6 in. and over	57.20@60.20	*52.00*	*57.00*	

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Jan. 3	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$73.00
4	55.00	55.00	50.00	75.00	$76.50	83.00
5	80.00	80.00		100.00	97.75	108.00
6	105.00	105.00	85.00	175.00	127.50	133.00
8	170.00	170.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.105	.....	.....	$0.15	$0.12	.....
4	...	.105	$0.11	$0.1175	.15	.15	$0.15
5	.....	.1575	.1375	.....	.23	.18	.18
6	$0.24	.1575	.165	.1645	.23	.21	.21
8	.38	.245	.26	.26	.35	.30	.325
10	.57	.3675	.338	.364	.53	.42	.476
12	.72	.4725	.442	.468	.68	.54	.612
15	1.13†	.63	.65	.78†	.90	**.90**	.884
18	1.65†	.875	.85	1.092†	1.25	1.32	1.153
20	1.98†	1.05	1.125	.....	1.50	.....	.....
22	2.64†	1.40	1.375	1.456†	2.00	.....	1.564
24	2.97†	1.575	1.625	1.872†	2.25	2.16	2.04
27	4.81†	2.795	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.096	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.14	....	4.45†	6.88†	.....	4.99
36	7.91†	4.715	....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	*$0.129*	*$0.198*	*$0.302*	*$0.585*	*$1.995*	*$5.98†*
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	.....	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	.475	1.65	.....
New Orleans	.145*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	.11*	.165*	.275	.425	1.625	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.117	.175	.273	.5265	1.755	3.9975
Kansas City, Mo.	.15*	.21*	.335	.52	2.09†	4.35†*
Philadelphia	.12	.18	.28	.54	1.80	**$.2275**

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Jan. 3	One Year Ago
New York, 45% asphalt.....(at terminal)	$0.053	$0.06
New York, 65% asphalt.....(at terminal)	.052	.06
New York, binder.....(at terminal)	.06	.0675
New York, flux.....(at terminal)	.06	.065
New York, liquid asphalt.....(at terminal)	.048	.07
St. Louis, 50@60% asphalt	.055	.045
St. Louis, 40@50% asphalt	.053	.
Chicago, 40–50% asphalt	.0525	.1525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.04
Dallas, 55% asphalt	.0455	.048
Dallas, binder	.061	.053
San Francisco, binder, per ton	9.50*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	$23.00*	$15.00†
Boston (*Mexican*)	*21.00*	*16.50*
Chicago (*Stanolind*)	22.25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.45	19.10
St. Louis (*Mexican*)	29.50	24.50
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	24.00	21.50
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)	17.50	13.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	19.00	16.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$140.00 per M.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	3.20 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	*126.00* per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3.05 per sq.yd.
	4x8x4 common	2.90 per sq.yd.
Kansas City	Granite	.... per sq.yd.
Philadelphia	Granite	3.75@4.50 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide ...No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., *$1.40* per lin.ft. *Chicago*: 5 x 18 in., $3.35 per lin.ft. delivered.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.58
New York (*delivered*)	3½	16	2.79
Boston	3½	18	*2.65*
Chicago	4	16	3.50
Chicago	3½	16	3.50
St. Louis	3½	16	*2.45*
St. Louis	4	16	*2.80*
Seattle	4	16	Off market
Minneapolis	3½	16	2.70
Atlanta	3½	16	1.90
New Orleans	3	16	2.50
New Orleans	3½	16	2.81
New Orleans	4	16	3.15
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	....
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Jan. 3	One Year Ago	Jan. 3	One Year Ago	Jan. 3	One Year Ago
New York (*alongside dock*)	$2.00	$2.00	$2.00	$2.00	$1.25	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.00	2.25	2.00	2.25	2.00	2.25
St. Louis	*1.40*†	1.45†	*1.45*†	1.50†	*1.20*†	1.45†
Seattle	1.25	1.00	1.25	1.00	1.25	1.00
Dallas	2.38	2.25	2.38	2.25	2.00	1.87½
Minneapolis	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati	1.35	1.25	1.35	1.25	1.30	1.15
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.40†	1.40	1.40†	1.40	1.10†	1.10
New Orleans	2.85	2.85	2.85	2.85	1.25	1.35
Los Angeles	2.50	....	2.50	....	1.75	....
Atlanta	1.75†	1.75†	1.75†	1.75†	1.20†	1.32†
Detroit	1.62	2.25	1.62	2.25	2.02½	2.00
Baltimore	1.40	....	1.60	....	0.70†	....
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.25†
Philadelphia	2.15	1.70	2.15	1.75	1.65†	1.65
Kansas City		2.00†		2.00†	0.66*†0	66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Jan. 3	1½ In. One Year Ago	¾ In. Jan. 3	¾ In. One Year Ago
New York	$1.65	$1.65	$1.75	$1.75
Chicago	2.00	2.25	2.00	2.25
St. Louis	2.25*	2.00	2.25*	2.10
Dallas	2.83	1.65	2.83	1.65
San Francisco	2.15	2.15	2.15	2.15
Boston	1.55*	1.70	1.55*	1.70
Minneapolis	1.85	2.00	2.00	2.25
Kansas City	1.50	2.40	1.50	2.40
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	1.90*	2.00*	1.90*	2.00*
Cincinnati	1.65	1.80*	1.65	1.80*
Los Angeles *delivered*	2.75		3.00	
Detroit	1.75	1.90@2.00*	1.75	1.90@2.00*
Baltimore	2.50		2.55	
Montreal	1.80*	1.80*	1.90*	1.90*
Philadelphia	2.15*	1.75*	2.15*	1.60*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	0.85	0.90	2.50	....
Birmingham, Ala.	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J.	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	24.00	20.00	2.62½*	2.62½*
Boston	*22.00*	*16.00*	*4.35**	2.95*
Dallas	*20.00*	....	....	1.85†
Cincinnati	16.80	14.30	....	....
San Francisco	22.00	....	....	2.10†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	....	....	2.70†
Detroit	20.00	19.00	18.00‡	18.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	....	18.50	....	2.00†
Baltimore	24.25	17.85	2.55	....
Montreal	21.00	21.00	....	9.50‡
Atlanta	23.00	14.00	2.25†	1.50†
New Orleans	....	....	2.40†	1.85†
Philadelphia	23.00	16.00	1.93*	1.24†
Kansas City	18.40	*15.00*	*2.45**	2.45*
Birmingham	14.50	13.75	2.00†	1.80†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Jan. 3	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.80	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.80	....
St. Louis (Carney)	*2.10*	1.75
Birmingham (Magnolia) pozzolan cement	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Jan. 3	One Month Ago	One Year Ago
New York, del. by truck	*$2.50@2.60*	$2.55@2.65	$2.60@2.70
New York, alongside dock to dealers	2.15	2.15	2.30
Jersey City	2.33	2.33	2.48
Boston	2.63	2.92	2.85
Chicago	2.10	2.10	2.05
Pittsburgh	2.19	2.19	2.14
Cleveland	2.41	2.41	2.36
Detroit	2.37	2.37	2.33
Indianapolis	2.31	2.31	2.26
Milwaukee	2.25	2.25	2.22
Duluth	2.19	2.19	2.04
Peoria	2.27	2.27	2.26
Cedar Rapids	2.38	2.38	2.33
Davenport	2.33	2.33	2.28
St. Louis	*2.20*	2.35	2.35
San Francisco	2.61	2.61	2.71
New Orleans	2.40	2.80	3.30
Minneapolis	2.42	2.42	2.29
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	2.05	2.05	2.25
Atlanta	2.35	2.35	2.54
Cincinnati	2.41	2.41	2.39
Los Angeles	3.16	3.16	....
Baltimore	2.50	2.61	....
Birmingham	2.80	2.80	2.40
Kansas City	2.27	2.27	2.45
Montreal	2.25	2.25	2.88
Philadelphia	2.41	2.41	2.51
St. Paul	2.42	2.42	2.29

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.85	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	1.95
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	1.95	Wyandotte, Mich.	2.10
Iola, Kan.	1.95	Alpena, Mich.	2.00
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	1.95	Kingsport, Tenn.	2.05

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	New York	St. Louis	Dallas	San Francisco
		Warehouse					
032	22	$0.95	$1.02	$1.24	$1.04	$1.12	$1.33
049	28	1.20	1.30	1.58	1.32	1.38	1.67
068	35	1.47	1.59	1.94	1.62	1.67	2.06
093	45	1.89	2.04	2.50	2.08	2.00	2.66
126	57	2.34	2.53	3.09	2.59	2.55	3.29
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.88	5.28	6.44	5.39	5.26	6.88
336	138	5.66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7.10	8.67	7.25	7.12	.....
		PAVING					
036P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1.80	2.20	1.83	1.90	.....
049R	24	....	1.10	....	1.12	1.07	.....
067R	31	....	1.40	....	1.42	1.39	.....
089R	40	....	1.80	....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22.00	$21.25	$20.72	$20.00	$25.50
26 "	2.5	22.00	22.50	22.39	19.11	27.58
25 "	3.0	22.00	25.25	24.93	.....	30.71
24 "	3.4	24.00	27.25	27.10	24.09	33.16
22 "	4.33	27.00	31.75	32.27	.....	35.10

*Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	New York	Chicago	St. Louis	Dallas	San Francisco
	Warehouse, Uncut						
½ and larger..	$2.40	$2.70	$3.54	$3.20	$3.35	$3.38	$3.65
⅜.....	2.45	2.80	3.59	3.25	3.45	3.43	3.75
¼.....	2.50	2.90	3.64	3.30	3.55	3.48	3.85
⅝.....	2.65	2.95	3.69	3.45	3.75	3.63	4.05
¼.....	2.90	3.00	4.04	3.70	4.35	3.78	4.65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.30	$3.05	$3.08	⅝.....	$2.70	$3.30	$3.30
⅜ in.....	2.40	3.10	3.13	¼.....	3.30	3.50	3.48
¼.....	2.50	3.15	3.18	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common Jan. 3	Common One Month Ago	Common One Year Ago	Paving Block 3-inch*	Paving Block 4-inch*
New York (del.).....	$23.65	$22.55	$23.65	$46.50	$54.00
New York (at dock)...	20.00	19.00	20.00	.....	.....
Chicago.....	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon.....	16@18	16@18	15.00	38@40	40@42.50
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	11.60	11.60	10.90	33.00	.....
San Francisco.....	15.50	15.50	15.50	.....	.....
Los Angeles	14.50	14.50	.....	(not used)	
Boston (del.).....	*21.00*	22.00	20.00	48.25	56.00
Minneapolis (del.).....	16@18	16@18	18@19	.....	.....
Kansas City.....	16.50	16.50	14.50	(no market)	
Seattle.....	15.00	15.00	14.00	55.00	.....
Cincinnati.....	20.00	18@19	17.00	*40.00*	*45.00*
Montreal	16.50	16.50	16.00	100.00‡	68.00
Detroit (del.).....	18.25	18.25	16.50@17.00	38.50	41.50
Baltimore (del.).....	21.00	21.00	.....	40.00	45.00
Atlanta.....	11.00	11.00	10.00	40.00	45.00
New Orleans.....	18.75	18.75	15.75	.....	.....
Birmingham.....	12.50@14.00	12.50@14.00	12.50	.....	.....
Philadelphia.....	*21.00*	22.00	20@28	38.00	46.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Jan. 3 on Trucks*	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.1179	$0.123	$0.0724	$0.125	*$0.08*	$0.108	.....
6x12x12...	.1769	.1844	.0996	.....	*.11*	.156	.....
8x12x12...	.2211	.2305	.1358	.215	*.145*	.244	$0.1968
10x12x12...	.....	.....	.1695	.....	*.17*	.....	.2442
12x12x12...	.....	.....	.1937	.....	*.215*	.....	.3175

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	*$0.125*	*$0.22*	.....
Minneapolis (f.o.b. cars).....	.07	.12	$0.20
Minneapolis (delivered).....	.075	.13	.21
Cincinnati.....	*.0795*	*.145*	.....
Kansas City.....	.0965	.168	.....
Denver.....	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles	.0931	.1686	.....
New Orleans.....	.12	.23	.....
Detroit (delivered).....	.1145	.2147	.27
Montreal.....	.115	.225	.30
Baltimore.....	.125	.27	.....
Atlanta.....	.1004	.1674	.....
Dallas.....	.11	.20	.285
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.08	.164	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
			Warehouse				
Beams, 3 to 15 in.....	$2.50	$3.00	$3.64	$4.40	$3.45	$3.30	$3.60
Channels, 3 to 15 in...	2.50	3.00	3.64	4.40	3.45	3.30	3.60
Angles, 3 to 16 in., ¼ in. thick.....	2.50	3.00	3.64	4.40	3.45	3.30	3.60
Tees, 3 in. and larger...	2.50	3.00	3.64	4.40	3.50	3.30	3.60
Plates, ¼ in. thick and heavier.....	2.50	3.00	3.64	4.40	3.45	3.30	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	New York Jan. 3	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
				Warehouse			
½ in. and larger	$2.90	$4.40	$3.85	$3.75	*$3.90*	$5.00	$4.90
CONE HEAD BOILER							
½ in. and larger	3.00	$4.50	$3.95	$3.85	*$4.10*	$5.20	$5.00
⅝ and ¾.....	3.15	4.66	4.11	4.00	*4.45@4.70*	5.35	5.15
⅞ and 1.....	3.40	4.90	4.35	4.25	*4.85*	5.60	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$3.00	$3.80	$4.25	$4.55	$3.36	$4.95
Cut.....	....	4.45	*5.25*	5.75	3.69	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½.....	*$9.20*	*$5.85*	$8.00
⅝.....	*7.40*	*5.60*	7.75
¾.....	*7.25*	*5.45*	7.70

Pittsburgh base in lots of 200 kegs or more, *$3.25@*3.50.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs *$2.31* per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4)in l) f.o.b. Philadelphia, l.c.l., $5.80 per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	38.75
Asphalt felt (light), per ton, f.o.b. plant*.....	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.....	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84 per cent from standard lists, f.o.b. New York; "A" grade less 83 per cent; "B" grade, 87 per cent; "B B" grade, 88 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	*$2.90@*$3.00	*$4.10*	$4.00	$5.00	$4.59
No. 12.....	*3.00@* 3.10	*4.15*	4.05	5.05	4.64
No. 14.....	*3.10@* 3.20	*4.20*	4.10	5.10	4.69
No. 16.....	*3.30@* 3.40	*4.30*	4.20	5.20	4.79
Black					
*Nos. 18 and 20.....	3.70	*4.55*	4.70	5.60	4.95
*Nos. 22 and 24.....	3.75	*4.60*	4.70	5.65	5.00
*No. 26.....	3.80	*4.65*	4.75	5.70	5.05
*No. 28.....	3.85	*4.75*	4.85	5.80	5.15
Galvanized					
No. 10.....	3.90@4.00	*4.75*	4.85	5.50	5.15
No. 12.....	4.00@4.10	*4.85*	4.95	5.60	5.25
No. 14.....	4.00@4.10	*4.85*	4.95	5.75	5.25
Nos. 17 to 21.....	4.30@4.40	*5.15*	5.25	5.90	5.55
Nos. 22 and 24.....	4.45@4.55	*5.30*	5.40	6.05	5.70
*Nos. 25 and 26.....	4.60@4.70	*5.45*	5.55	6.20	5.85
*No. 28.....	4.90@5.00	*5.75*	5.85	6.50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York Jan. 3	New York One Year Ago	Chicago Jan. 3	Chicago One Year Ago
Raw in barrels (5 bbl. lots).....	$0.95	$0.93	$0.94	$0.98

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Jan. 3	1 Yr. Ago	Jan. 3	1 Yr. Ago
Red	14.00	13.50	15.50	15.00
White	14.00	13.50	14.00	13.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	*$37.00*	*$38.00*	*$39.00*	*$42.00*
3x6 and 8	*37.00*	*38.00*	*39.00*	*42.00*
4x4-6 and 8	*37.00*	*38.00*	*39.00*	*42.00*
3x10 and 12	*37.00*	*38.00*	*39.00*	*42.00*
3x14	*39.00*	*39.00*	*41.00*	*43.00*
4x10 and 12	*37.00*	*38.00*	*39.00*	*42.00*
4x14	*39.00*	*39.00*	*41.00*	*43.00*

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	*$39.00*	*$41.00*	*$43.00*
6x14	*44.00*	*46.00*	*48.00*
8x10	*39.00*	*41.00*	*43.00*
8x14	*44.00*	*46.00*	*48.00*

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	**$43.00**	**$44.00**	$42.50	$44.50
3x10 to 10x10	**48.00**	**49.00**	48.50	50.50
3x12 to 12x12	**53.00**	**54.00**	55.50	57.50
3x14 to 14x14	**58.00**	**59.00**	61.50	63.50
3x16 to 16x16	**63.00**	**64.00**	69.50	71.50
3x18 to 18x18	**71.00**	**72.00**	79.50	81.50
4x20 to 20x20	.....	.....	89.50	91.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	**$68.00**	*$95.00*†	**$63.00**	**$63.00**	*$80.00*	*$110.00*†
Seattle	.....	29.50	.....	.....	.....	**30.00**
New Orleans	28.00	.....	.....	.....	31.00	.....
Baltimore	33.50	53.00	53.00	60.00	38.00	53.00
Cincinnati	40.00	*74.00*	*74.00*	*88.00*	44.00	*78.00*
Montreal	50.00	.....	.....	.....	.....	65.00
Los Angeles	.....	*49.00*	.....	.....	.....	*50.00*
Denver	.....	40.75	40.75	40.75	.....	41.75
Minneapolis	**44.00**	44.75	41.50	.....	**47.00**	45.75
Atlanta	33.00	.....	.....	.....	37.00	.....
Dallas	50.00	.....	.....	.....	54.75	.....
Kansas City	**44.75**	.....	.....	.....	**58.75**	.....
Birmingham	30@35	.....	.....	.....	40@45	.....
Philadelphia	*50.00*	*40.00*	*43.50*	*48.00*	*60.00*	*41.00*
Detroit	43.75	49.75	.....	.....	56.75	52.25
St. Louis	42.00	.....	.....	.....	*52.00*	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	**$50.00**	*$65.00*†	**$52.00**	**$65.00**	*$85.00*†
Seattle	.....	25.00	.....	.....	29.00
New Orleans	**72.00**	.....	.....	31.00	.....
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	*75.00*	*80.00*	*75.00*	35.00	*88.00*
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	*44.00*	.....	.....	.....
Denver	.....	31.25	31.25	.....	33.25
Minneapolis	**47.00**	**40.75**	39.50	**42.00**	**38.25**
Atlanta	17.50	.....	.....	27.00	.....
Dallas	50.00	.....	.....	53.33	.....
Kansas City	75.50	46.00	.....	**64.75**	.....
Birmingham	24@28	.....	.....	32@36	.....
Philadelphia	**33.00**	*40.00*	*43.00*	50.00	*39.00*
Detroit	49.00	38.00	.....	41.50	39.50
St. Louis	**42.00**	.....	.....	**30.00**	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Jan. 3	One Month Ago	One Year Ago
$2.65	$2.65	$2.00@2.05

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅜-in., 8 ft., ½-in., 6; ⅝-in., 4½; ¾-in., 3½; 1-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.15@.17*	New Orleans	*$0.15½*
New York	.17½	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	.17½	St. Louis	.16½
San Francisco	.15	Montreal	.22
Atlanta	.25	Detroit	.20
Denver	15½@16½	Baltimore	.18
Cincinnati	.19	Kansas City	.17½
Dallas	.21	Birmingham	.20½
Philadelphia	.17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.2125	.2325
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2225	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1975	.2225
Atlanta	.23	.2550
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	*4.75@4.90*
Soda ash, 58%, in bags, per 100 lb.	1.38@1.45
Chlorine, liquid, cylinders, 100 lb., per lb.	.08½@.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	1.75

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.26	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.